May 1994 Issue #33

Radio Fun

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"The beginner's guide to the exciting world of amateur radio."

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Radio Pioneers: Who Were They?

Before the turn of the century, a select group of determined experimenters set off on a journey that would change the world forever. By the 1920s, their inventions could fill a store like this one. Trace their footsteps, starting on page 11—see "Who Really Invented Wireless?". (Photo courtesy of Bruce Kelley W2ICE, Curator, Antique Wireless Association Electronic Communication Museum.)

This is Only a Test

One more relic of the Cold War is quickly fading into obscurity. The FCC has announced it is dismantling the 42-year-old Emergency Broadcast System and replacing it with a new computer-based system.

Under the EBS, a daisy chain of phone calls among officials and broadcasters was designed to get the word out to the public. Under the new system, emergency broadcasts will be computerized and automatically sent to radio and TV stations, cable systems, and satellite operators. *TNX The Independent Repeater Association's "The Purple Crystal," No. 36, February, 1994.*

Once and For All

The ARRL has petitioned the FCC to make amateur radio operators' licenses valid for the life of the holder. The League said in its January 6th petition that there is nothing in the Communications Act of 1934 that would prevent a lifetime license term for amateurs, and said the measure would allow inactive amateurs to return to service at the same class of license without retesting. The League says the number of amateurs who could stand to benefit from a lifetime ticket is significant.

Under the current 10-year license structure, the League says it is already possible for relatively inactive hams to remain licensed during periods of extended inactivity. The ARRL says there is no practical difference, then, between such a person and one who allows his or her license to expire and later wants to return to amateur radio. Currently, there is only a two-year grace period under which a lapsed license can be reinstated without the need for re-testing. *TNX Westlink Report, No. 665, January 24, 1994.*

Try, Try Again

By the time you read this, the Earthwinds Hilton around-the-world balloon project may be launched for the fifth time! Hams around the world are looking forward to working the capsule simplex on 145.55 MHz.

Launch attempt #4 took place in January. Shortly after a seemingly perfect liftoff from Stead Field Airport in Reno, Nevada, the flight was doomed by a frozen vent valve, and the balloon had to land in an open field just west of Fresno, California.

In a previous attempt a surprise temperature inversion layer prevented the craft from gaining enough altitude to clear the Sierra Mountains. At each attempted flight, ham radio operators on the ground were instrumental in maintaining safety communications for the mission. Two of the three crew members are licensed hams.

Still, after four failed attempts, organizers and crew remain optimistic. If successful, the Earthwinds balloon is expected to circle the earth following the jet stream in 12 to 21 days. *TNX W5YI Report, Issue #3, February 1, 1994.*

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Please write to **Lodging, Dayton Hamvention, Chamber Plaza, 5th & Main Streets, Dayton, OH 45402-2400** or refer to our 1993 Hamvention program for a listing of hotel/motels in the Dayton area.

Special Awards

Nominations are requested for Amateur of the Year, Special Achievement and Technical Excellence awards. Refer to the Hamvention Program for nomination form or contact Hamvention Awards Chairman, Box 964 Dayton, OH 45401-0964.

1994 Deadlines

Award Nominations: March 1
Advance Registration and Banquet
USA - April 8 Canada - April 1
Flea Market Space: February 1

Flea Market

Flea Market Tickets (valid all 3 days) will be sold IN ADVANCE ONLY. No spaces sold at gate. A maximum of 3 spaces per person (non-transferable). Electricity is available in a portion of the last Flea Market row for $40 additional per space. Rental tables and chairs are not available in the Flea Market. Vendors ***MUST*** order an admission ticket when ordering Flea Market spaces. Please send a separate check for Flea Market space(s) and admission ticket(s). Spaces will be allocated by the Hamvention committee from all orders received by February 1. Please use 1st class mail *only.*

Notification of Flea Market space assignment will be mailed by March 15, 1994. Checks will not be deposited until after the selection process is complete.

License Exams

Novice thru Extra exams scheduled Saturday and Sunday only. Send FCC form 610 (Aug 1985 or later) - with requested elements shown at top of form, copy of present license and check for prevailing rates (payable to ARRL/VEC) to Exam Registration, 708 Mapleside Dr. Trotwood, OH 45426

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* $14.00 at door
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QLF

by Wayne Green W2NSD/1

Is There Life?

You are not holding up your end and I am very disappointed. Look, the editors are doing their bit, giving you an interesting publication every month. And I'm doing my bit with my editorials, which I think you're enjoying. But *Radio Fun* is supposed to be a communications medium and not just an entertainment magazine.

The *Radio Fun* mission is to help newcomers to amateur radio get up to speed and to have more fun with this hobby. But I'm not going to write everything. I'm depending on you to hold up your end, so I expect you to be writing articles and letters telling me what you're doing. We need articles to help newcomers get their higher class licenses. We need articles on how to get started with all of the fun things you can do with this wonderful hobby. We need articles on DXing, going on DXpeditions, satellite communications, QRP, repeaters, packet radio, slow-scan, AMTOR, RTTY, high-speed CW, Clover, fox-hunting, making clubs work better, publishing club newsletters, UHF experimenting, home construction, beacon transmitters, ATV, 160m DXing, 75m DXing, 6m, certificate hunting, contesting, antenna design and experimenting, kit construction, and so on.

We also want to know what you think of any new piece of equipment you've bought. How is it? What modifications have you made and why? Do you recommend it?

Have you been helping us get new hams? So where are the pictures?

What have you done in the hobby that's been particularly interesting? How about ham public service? Emergencies?

Okay, if you are a seriously negative person, what are some of your gripes about what's been going on and what do you recommend as a solution?

Have you worked out a way to get the hams you contact to actually talk with you, or are you still just logging calls and names and moving on? Roger on the rig. Roger on the antenna. Roger on the microphone serial number. Back to you.

Somehow I'd like to help you have as much fun with amateur radio as I have. And I'd like to have you help me have more fun. I've had a ball meeting tens of thousands of hams all around America, and in over a hundred other countries (so far). I've worked the pile-ups from all around the world, from VR2FD, JY8AA, 7P8CD, KC4AF, HL9WG, FO8AS, 4U1ITU, YA1NSD, and a long list of other rare spots.

Tell you what, if you send a letter I can publish, you'll get a year's extension to your *Radio Fun* subscription!

Speaking of Subscriptions

In addition to our wanting to keep you as a reader of *Radio Fun,* I'd also like to get you sucked into subscribing to *73 Amateur Radio Today.* You like construction articles, right? Well, please make a guess as to which ham magazine publishes by far the most construction articles. No, we don't have 50 pages of operating news every month. And we don't have endless pages of club news. And we don't have endless contest announcements and results. If you're really into contests, get *CQ.*

Then there are our new equipment reviews. Which ham magazine publishes the most reviews, and which gets the news to you faster? Yep, it's *73*, and by a wide margin.

One of the things most *73* readers enjoy are my endless editorials. Well, they're different from anything I've seen anywhere since John Campbell W2ZGU, the editor of *Analog*, died around 30 years ago. Oh, I write about amateur radio, but I also write about the places I've visited, the things I've done, the interesting conferences I've attended, the books I've read recently, and so on. I've helped thousands of hams to better health and to be successful. I raise hell with smokers and beer-guzzlers.

When repeaters got started I published hundreds of articles, endless books, and *The Repeater Bulletin.* It turned our repeaters into the cellular telephone industry, where a bunch of hams made fortunes. Then came the microcomputer. Again I published endless articles in *73*, started new magazines such as *Byte, Microcomputing, 80 Micro, InCider, Run, Hot Coco, Selling Micros, Desktop Computing, Pico,* and *Kilobaud,* plus published dozens of books. A bunch more hams paid attention and made fortunes.

Now I'm onto a whole new technology that looks like it'll grow into a multi-trillion dollar industry. More hams are going to get disgustingly rich. Plus there's that elusive information superhighway which is beginning to be graded and paved here and there. More opportunities for riches.

Customer Service

We've had nothing but aggravation with the outfit that does our mailing labels for us. Oddly enough, even at this late date I haven't found software which will allow us to handle the job in-house, so we're a prisoner of remote incompetence. Expensive incompetence. I'll bet I get a dozen letters a month from readers who are absolutely furious with me over subscription problems. Lordy, I wish I had the time to handle the subscriptions myself. This is one area where I've seen pathetically little improvement in the last 30 years. It's one into which I've poured hundreds of thousands of dollars and gotten endlessly screwed for my trouble. Counting the lost business involved, I can honestly claim a loss in the millions.

But, as I've always said, if you have any trouble with my magazines, or with any other company in the ham industry, please let me know. I've a pretty good record of helping readers with problems. RF

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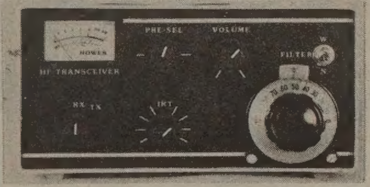

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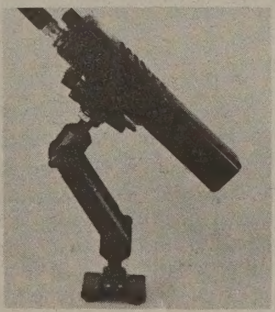

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"Q" is Quality

by Larry R. Luchi W7KZE

[Editor's Note: This technical discussion of "Q" is a bit more advanced than what we usually publish in Radio Fun, *and it may leave some of you in the dark. If so, read it through a few times—slowly—and things should begin to sink in. If you want to get the most out of amateur radio, you've got to really understand this stuff—not just memorize a bunch of answers for a test. We've asked Mr. Luchi to prepare a series of articles focusing on various electronic components and their properties. We'll publish them from time to time, and if you stick with them, you'll be well on your way to a solid foundation in electronics—David N1GPH]*

In the October issue of *Radio Fun* we discussed resonance. Now we will learn about the quality, or "Q," of a circuit. This will fine-tune our understanding of a resonant circuit and further our knowledge of filters.

Q is a term often applied to AC circuits in which inductance and capacitance are involved. The symbol Q can be considered to mean "quality." A coil with no resistance or other losses would be an ideal or perfect inductor and have an infinitely high Q. Since a coil without losses is not possible in real life, the Q of a coil will always have some finite value. Q is a ratio of reactance to resistance, and is expressed by the formula:

$$Q = \frac{X_L}{R} = \frac{2\pi L}{R} \qquad \text{Equation 1}$$

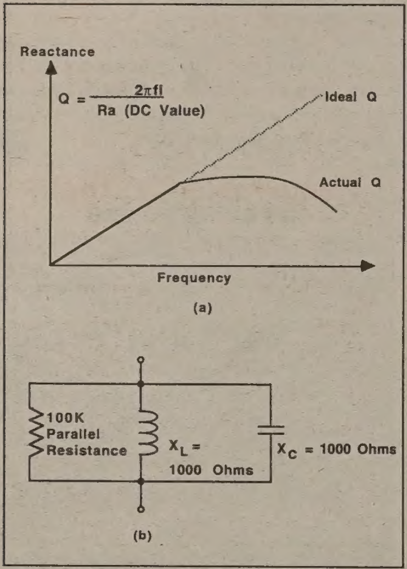

Figure 1. The relationship of ideal Q and Q with resistance added.

From the formula, an inductor should have a higher Q if used in higher-frequency circuits.

At higher frequencies, however, electrons flowing in a wire or coil travel more near the surface of the wire. Thus, only a small portion of the conductor is actually carrying current. The lessening of the usable cross-sectional area results in an effectively higher resistance of the same size wire to the higher frequencies, including RF. This increased resistance, known as *skin effect*, is one cause of lower Q in a coil or inductor. Skin effect can be decreased by 1) using larger wire; 2) silver-plating the wire used, since silver is a more conductive material; or 3) using fewer turns but increasing the permeability of the core by using powdered-iron cores.

The Q of a parallel-resonant circuit tells you the relative merits of that component, or its quality factor. It is defined as the ratio of reactance to resistance. Adding a resistor to a parallel-resonant circuit causes the bandwidth to increase while the Q decreases. This is illustrated in Figure 1.

The Q in a parallel resonant circuit with parallel resistance is found by dividing the parallel-resistance value by the inductive reactance.

$$Q = \frac{R}{X_L} \qquad \text{Equation 2}$$

Calculating Q in an Inductive Circuit

Example: A parallel-resonant circuit has a resonant frequency of 3.625 MHz and an inductor of 43 µH, with a resistor value of 1800 ohms. What is the Q of the circuit?

$$X_L = 2\pi fL \qquad \text{Equation 3}$$

ENTER	DISPLAY
6.28 [X] 3.625 [EXP] 6 [=]	2276500
[X] 43 [EXP] [+/-] 6 [=]	978.895

$X_L = 979\,\Omega \quad Q = \dfrac{1800}{979}$ or a Q of 1.84

Capacitors also have a value of Q. As with coils, the Q is the ratio of the capacitive reactance to the effective resistance of the capacitor. This resistance may be in the leads, may be skin effect, or may be the result of internal losses of the capacitor. The formula is:

$$Q = \frac{XC}{R} \qquad \text{Equation 4}$$

From this formula, the Q of a capacitor should be halved when it is used at twice the frequency. Thus the Q of an LC circuit should decrease somewhat if tuned to higher frequencies.

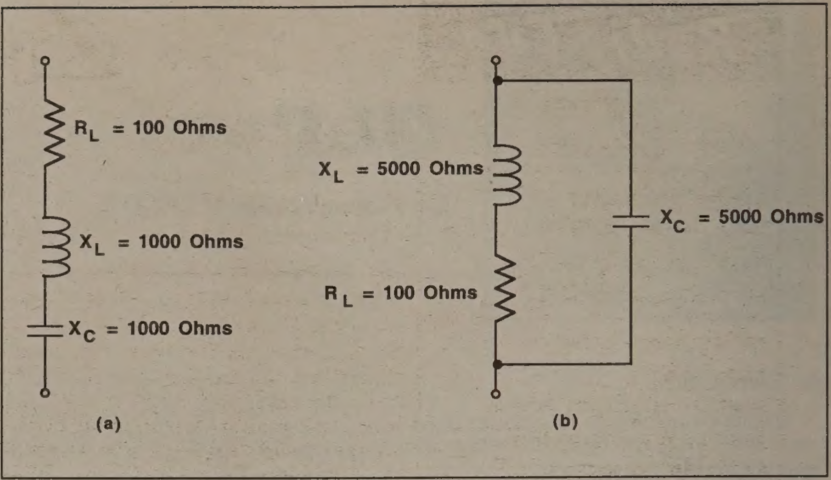

Figure 2. Series and parallel resonant circuits.

When a resistance is in series with any reactance, an increase in resistance produces a lower Q. When a resistor is connected across a coil or capacitor, however, the effective Q of the circuit will vary directly with the value of the resistance. A high shunting resistance means a high Q; a low parallel resistance means a low Q. Therefore:

$$Q_p = \frac{R}{X_L} \quad \text{or} \quad Q_p = \frac{R}{X_C}$$

The Q in a series-resonant circuit (Figure 2a) and a parallel-resonant circuit (Figure 2b) can be found by dividing the inductive reactance by the resistance:

$$Q = \frac{X_L}{R}$$

In Figure 2b, you will see a parallel resonant circuit with a capacitor in parallel. The Q is found by dividing the capacitive reactance by the resistance:

$$Q = \frac{X_C}{R}$$

The dielectric materials of capacitors normally have extremely high resistance, in the hundreds of thousands of megohms. If the dielectric leaks even a little, however, the ratio of resistance across the capacitor decreases tremendously, lowering the Q of the capacitor as well as the Q of any resonant circuit in which it is used.

A shunt resistor is often connected across a parallel inductive-capacitive (LC) circuit to lower its Q. This makes the circuit less sensitive to any one frequency. A parallel resonant circuit with a loading resistor shunted across it to lower the Q is shown in Figure 1. The lower the value of the parallel resistance, the greater the proportion of resistive current flowing in the circuit. With so low a resistance the source sees the LCR circuit more as a resistance than as a resonant circuit; the circuit has low impedance. Because of the resistance, current of all frequencies will flow from the source to the circuit. Higher Q in a resonant circuit will mean proportionally greater current will flow within it at the resonant frequency.

Calculating Q in a Capacitive Circuit

Example: Solve for X_C where Capacitance = 100 pF, the frequency is 1 MHz, and there is a 100k ohm resistor across the circuit, as shown in Figure 1.

$$X_C = \frac{1}{2\pi fC} =$$

ENTER	DISPLAY
6.28 [X] 1 [EXP] 6 [=]	6280000
[X] 100 [EXP][+/-] 12 [=]	0.000628

[1/X] 1592.356688 X = 1592

1592 [÷] 100,000 Q = 0.016

Since the Q of a coil is usually much lower than the Q of a capacitor, the coil is the controlling factor for the Q of LC circuits. Some of the methods of attaining a higher-Q coil are: 1) using larger or more conductive wire to reduce skin effect; 2) spacing the wire of the coil by a distance approximately equal to the diameter of the wire used; 3) using a coil with a length slightly greater than its diameter (for single-layer coils); 4) using low-loss core materials to decrease eddy-currents and hysteresis losses; and 5) insulating the wire with a material that has low dielectric hysteresis loss. This increases the Q of the capacitance that exists between adjacent turns in a coil, known as *distributed* capacitance.

The Q of resonant circuits used in amateur radio may be about 5 to 15 in ham transmitters, 25 to 200 in RF tuned circuits in receivers, or several hundred in specially designed high-Q filter circuits. In my next article we will discuss these high-Q filter circuits. 73, W7KZE **RF**

You are encouraged to contact the author for further information. Write to: Larry R. Luchi W7KZE, Electronics Instructor, 9001 Airport Road, Everett WA 98204.

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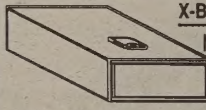

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editor/publisher
Wayne Green W2NSD/1
associate publisher
David Cassidy N1GPH

managing editor
Hope Currier
senior/technical editor
Charles Warrington WA1RZW
editorial associates
Chris Aubert
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contributing editors
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Jeffrey Sloman N1EWO
Gordon West WB6NOA

advertising sales representative
Doug Johnson
advertising coordinator
Judy Walker
603–924-0058
800–274-7373
FAX 603-924-9327

graphic design
Suzanne Self

desktop page make-up
Suzanne Self

circulation manager
Harvey Chandler
subscription services
800-257-2346

Wayne Green, Inc.
editorial offices
Radio Fun
70 Route 202-North
Peterborough, NH 03458
603-924-0058
FAX: 603-924-9327

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letters

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Please write to us! Tell us what you've been doing, what you think of ham radio, and what you like or don't like about *Radio Fun*. Starting with the June 1994 issue, if we publish your letter, you'll get a free one-year subscription (or extension) to *Radio Fun*. Send your letters to us at the address above, or fax us at (603) 924-9327. Be sure to type or print legibly, and include your full name, callsign, and complete address.

Grady W. Eaton, Milton FL Wayne, I read your January 1994 "QLF" column and appreciated your historical background comments on amateur radio. A great big "thank you" to all hams who kept this hobby(?) alive until I finally took the plunge.

Like you, I believe there is an ongoing need and ample room for changes in the licensing/delicensing procedures currently in effect.

Prior to attending a Novice class, the only contact I had with amateur radio was a couple of phone patches from exotic parts during my Navy career. I was also familiar with what a Collins KWM-2 rig looked like as I flew for two years with one sitting above my head. Sure, I turned the knobs and twisted the dials but the only thing I knew was that a meter was about 39" or so.

My relatively brief (so far) experience in ham radio has increased my knowledge of it several times over and yet I remain a know-nothing. I do know this, however: Due to age, health or what-have-you, I will probably never rise above my present classification due to antiquated procedures currently in effect.

I will therefore stick with my '735 and a dipole, and well over $700-worth of antennas will remain "new-in-the-box." I don't expect to purchase any more major items under the current situation.

As for radio clubs, I have supported one school club to the tune of four or five $100 donations, with nary a word of "thank you." I will, however, continue to support a club, but it will be one closer to home. I can appreciate the educational value of this hobby.

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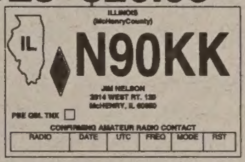

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CIRCLE 68 ON READER SERVICE CARD

RF vintage review

The Lafayette KT-200 Receiver

by Allie C. Peed, Jr. K2DHA

As a kit, the KT-200 represents a departure from the usual kit practices. As soon as you unpack it, you'll note that by usual kit standards you are about half-finished already. All of the mechanical mounting is already completed for you. Tube sockets, transformers, main tuning capacitor, filter capacitor, controls, and even knobs and pilot lamps are all in place. The tuning mechanism is already installed and operative. The dial cords are strung and the flywheels are in place. And, best of all, the complex assembly of coils and alignment capacitors for the oscillator, mixer, and RF amplifier stages are mounted and prealigned, but more about this later.

Circuitwise, the KT-200 is conventional, straightforward, and a good design. It consists of a 6BD6 RF amplifier, a 6BE6 mixer, a separate 6BE6 oscillator, two 6BD6s as 455 kHz IF amplifiers, a 6AV6 detector, AVC rectifier, and first audio amplifier, another 6AV6 BFO (Beat Frequency Oscillator) and shunt-type noise clipper. A 6AR5 serves as the audio power amplifier and a 5Y3 as the rectifier completes the nine-tube complement.

Many receivers commonly use a single 6BE6 pentagrid tube as both oscillator and mixer. However, in the interest of stability, the designers of this circuit have chosen to devote separate 6BE6s to the mixer and oscillator functions. This contributes to stability since it greatly reduces the tendency of the oscillator to "pull" on strong signals and probably it also lessens thermal drift problems.

AVC voltage is applied to both the RF and IF amplifier stages. A front panel control provides for disabling the AVC in its MVC (Manual Volume Control) position. This same switch in its third position (BFO) serves the dual purpose of turning on the beat oscillator and disabling the AVC for copying CW or SSB signals.

Instead of the traditional RF gain control, the KT-200 is provided with a manual IF gain control. Thus, the RF amplifier runs fully open all the time except as modified by the AVC bias. The IF gain control is simply a 10k potentiometer in series between ground and the two cathodes of the IF amplifier tubes. Therefore it does not afford a complete range of control from cut-off to full gain as is the case with RF gain controls. It does, however, provide sufficient control to keep strong signals from over-driving and distorting.

A stand-by switch opens the plate supply lead to the RF amplifier, mixer, and oscillator stages while leaving the remainder of the stages powered. This is perfectly adequate and probably contributes to quick recovery time and stability when break-in operation is used. The stand-by switch terminals are brought out to a five-pronged socket on the rear apron of the chassis for connection to a break-in relay in the station control system if desired.

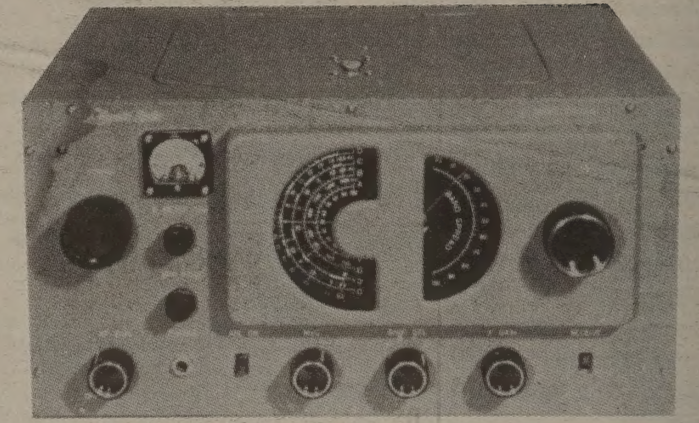
All of the components are of Japanese manufacture and appear to be of excellent quality. The use of a few wax impregnated bypass capacitors is probably the lone exception. While these are of good quality, modern receiver construction practice is to use plastic or ceramic encapsulated capacitors which can be expected to give longer service.

The cabinet, panel, and chassis are a pleasant surprise. They are of heavy-gauge steel, including two heavy diagonal braces between the chassis and top of the front panel. This contributes to the receiver having the ruggedness of a piece of military gear when completed. It should assure good mechanical stability of the finished assembly. The cabinet and panel are finished in gray wrinkle finish, and the cabinet is provided with numerous louvers to allow good circulation and heat dissipation from the interior. Both bottom and top are provided with hinged access doors of ample size and good fit.

A unique feature of the chassis is that ground points are formed by punching out "U-shaped" tabs in the chassis. These are bent out from the underneath side of the chassis by the constructor and ground leads are wrapped around them and soldered. This feature should give positive grounds, avoiding difficulties with loosening of screwed-on ground lugs and interface corrosion between ground lugs and the chassis. However, the kit builder using a low-wattage soldering iron might encounter difficulty in heating these ground tabs hot enough to assure a good solder job.

The S-meter is 1-1/2"-square and it is connected with a multiplying resistor and calibration control from the cathode of the RF amplifier to ground. Essentially, it measures the voltage developed on the cathode, which is a direct function of the strength of the received signal. Calibration of the S-meter is accomplished by temporarily shortening the antenna terminals on the back of the set and adjusting the "S-Meter Adjust" control on the front panel until the meter reads zero. Unfortunately, this zero position varies from band to band and requires frequent re-adjustment if you are band-hopping. When the meter is adjusted to give proper readings on the shortwave bands, switching to the broadcast band will pin the meter unless you back off on the control. Then you are out of calibration when you return to the higher frequency bands. Perhaps the best operational scheme here is to tune the receiver to a clear spot on the band in question and adjust the control to make the meter read just slightly above zero. Your S-meter readings then will be in terms of signal strength above background noise, which is a meaningful relative reading.

Assembly of the kit consists chiefly of wiring in all of the components which are mounted on their pigtail leads, and connecting the terminals of those items which are premounted on the chassis and panel. The only part which might be considered difficult is the wiring of the bandswitch since this requires careful attention to directions, and some work in rather cramped space at times. Total wiring time for a careful, experienced worker shouldn't exceed 10 to 12 hours, and even the rankest novice kit constructor should be able to complete the job in 15 to 20 hours.



Pre-Alignment

Your writer has, through experience, developed a tongue-in-cheek attitude toward kits which are sold claiming pre-alignment of the tuned circuits. Most such kits result in a completed unit which is aligned well enough to work after a fashion, but most of them require alignment for optimum operation. The KT-200 proved to be almost an exception, however. By virtue of the fact that the tuning coils and capacitors are premounted and aligned, the overall alignment was quite good and only required a minimum of touching up to achieve the sensitivity and selectivity claimed in the specifications. In particular, the frequency calibration of the main tuning dial scales was outstanding. Anyone who has ever spent hours tuning between the top and bottom of four bands while juggling padder and coil adjustments will certainly be appreciate this feature of the KT-200.

Similarly, the IF transformers were close enough to proper alignment to allow them to be peaked by ear by the kit constructor who is not equipped with a signal generator and voltmeter. The only exception to this good alignment was the BFO coil, which was considerably out of tune. However, this is aligned by simply adjusting the core until a zero beat is heard in the speaker or phones, and hence it was not difficult to bring into line.

It was previously mentioned that frequency calibration of the main tuning dial was excellent. However, two-dial tuning of this type in general suffers from poor re-set accuracy and since, in this case, the main tuning dial does not have index marks for setting to the amateur bands, location of the ham bands becomes a small problem. The bandspread dial is not calibrated, except for an arbitrary 0-100 logging scale. The selectivity of the receiver is good enough to justify the use of a great deal of bandspreading; i.e. the bandspread control provides for a slow tuning rate, enabling accurate tuning. But, this good feature is at the expense of coverage on the bandspread dial and one complete sweep of the bandspread scale does not cover fully any ham band in its entirety. It is necessary to re-set the main tuning in order to tune a whole band.

If a 1,000 kHz crystal calibrator is available, it can be used to good advantage in spotting the proper ham band settings of the main tuning. Set the bandspread dial to 100 (maximum capacity) and tune in the 1,000 kHz marker at the lower end of the band in question. Then the bandspread will tune up the band from the lower edge. At the limit of the bandspread tuning if you wish to tune further up the band, it will be necessary to "fudge" the main tuning up a fraction. In practice, this isn't as much of a handicap as it sounds since the bandspread is sufficient to cover the entire phone or CW subband on most of the bands, and it is seldom that an operator operates both modes at one operating session.

The lack of bandspread calibration is no real handicap in modern operation, which calls for zero-beating the station that you are working with your transmitter VFO. You must, however, assure yourself that your transmitter is operating within the proper frequency limits by some other method than your receiver's calibration, unless you provide the receiver with a crystal calibrator and learn to use it properly.

Mechanically, the bandspread tuning is interesting. In the main tuning capacitor, one plate is omitted in the center of each of the three rotor sections. Then, on a separate shaft from the opposite side of the capacitor, a single plate is turned into this gap in each stator section from the bandspread tuning shaft—a very neat arrangement.

The instruction manual is quite complete, but there are a sprinkling of errors and omissions which must be watched. For example, a correction sheet enclosed with this particular kit changed the instructions for wiring the

Continued on page 8

RF Hazards

The FCC is considering new rules which could require radio amateurs and others to show they comply with certain standards of radio frequency radiation safety. Those guidelines have been recommended jointly by the American National Standards Institute (ANSI) and the Institute of Electrical and Electronic Engineers (IEEE).

The Commission's proposal raises complex engineering and public health issues. Compliance could cost in the millions.

For the last decade, the FCC has required commercial broadcasters to prove their operations do not expose their employees or the public to RF radiation in excess of the ANSI standards. Until now, amateurs have been exempt from these regulations. In addition, the guidelines were updated in 1992 and the FCC may decide to adopt these much stricter standards.

At press time, the Commission had extended the comment period on Docket 93-62 three times at the request of various industry groups. *TNX W5YI Report, Issue #3, February 1, 1994.*

Shuttle Ride Was a GaAs

If you have ever built a project utilizing a GaAsFET, varactor, or diode, you already know the value of semiconductor devices made with gallium arsenide. Now the market for gallium arsenide could go sky high after the February flight of the space shuttle *Discovery.*

Astronauts conducted epitaxial thin-film growth experiments in what NASA calls the Wake Shield Facility—a 12-foot-diameter stainless-steel disk used to create an ultra-vacuum in space for epitaxial growth of these GaAs thin films. The vacuum created was designed to be thousands of times more effective than the best laboratory could create on earth.

A consortium of high-tech companies, universities, and government laboratories is sponsoring the program, which is projected to continue through 1997. If successful, devices grown in space could find applications in digital cellular phones, high-definition television, fiber-optic communications, opto-electronics, and perhaps your next home-brew project. *TNX Electronic Engineering Times, Issue 783, February 7, 1994.*

Nerdfest '94

Where can you go for a good time if you are technically savvy but dress in clashing outfits and bandaged glasses? The Dayton Hamvention? Not necessarily.

After withstanding years of snickers for their less-than-fashionable clothing and stunted social skills, more than 2,000 so-called "nerds" emerged from their computer cubicles to attend "Nerdstock" at a Dallas convention center in February. The computer jock's equivalent of Woodstock was organized by Computer Associates to honor software and technical support types who identify with the nerd lifestyle.

Organizers warn you should not confuse nerds with "geeks," another misunderstood subculture. Computer Associates Chairman Charles Wang said, "A nerd is a dedicated technologist who may not care how he or she dresses. A geek is someone who doesn't care how he dresses—but can't handle technology." In all seriousness, Wang said that nerds are vital contributors. The convention was criticized by an official from the IEEE for reinforcing a negative stereotype. *TNX Electronic Engineering Times, Issue 786, February 28, 1994.*

TAPR Has Moved

Tucson Amateur Packet Radio has relocated to new offices. The new mailing address is: **Tucson Amateur Packet Radio**, 8987-309 E. Tanque Verde Rd. #337, Tucson, Arizona 85749-9399. The voice telephone number is (817) 383-0000; FAX (817) 566-2544. *TNX W5YI Report, Issue #3, February 1, 1994*

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- All units available in 220 VAC input voltage (except for SL-11A)

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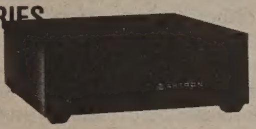

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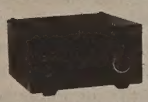
SL-11A	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R	•	•	7	11	2⅝ × 7 × 9¾	12
SL-11S	•	•	7	11	2⅝ × 7⅝ × 9¾	12
SL-11R-RA		•	7	11	4¾ × 7 × 9¾	13

RS-L SERIES



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RS-4L	3	4	3½ × 6⅛ × 7¼	6
RS-5L	4	5	3½ × 6⅛ × 7¼	7

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MODEL RM-35M

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MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
RM-60A	50	55	7 × 19 × 12½	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50
RM-60M	50	55	7 × 19 × 12½	60

RS-A SERIES

MODEL RS-7A

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A		•	2.5	3	3 × 4¾ × 5¾	4
RS-4A	•	•	3	4	3¾ × 6½ × 9	5
RS-5A		•	4	5	3½ × 6⅛ × 7¼	7
RS-7A	•	•	5	7	3¾ × 6½ × 9	9
RS-7B	•	•	5	7	4 × 7½ × 10¾	10
RS-10A	•	•	7.5	10	4 × 7½ × 10¾	11
RS-12A	•	•	9	12	4½ × 8 × 9	13
RS-12B		•	9	12	4 × 7½ × 10¾	13
RS-20A	•	•	16	20	5 × 9 × 10½	18
RS-35A	•	•	25	35	5 × 11 × 11	27
RS-50A	•		37	50	6 × 13¾ × 11	46
RS-70A	•		57	70	6 × 13¾ × 12⅛	48

RS-M SERIES

MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46
RS-70M	57	70	6 × 13¾ × 12⅛	48

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VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Colors Gray	Colors Black	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	•	•	5	7	4 × 7½ × 10¾	10
RS-10S	•	•	7.5	10	4 × 7½ × 10¾	12
RS-12S	•	•	9	12	4½ × 8 × 9	13
RS-20S	•	•	16	20	5 × 9 × 10½	18
SL-11S	•	•	7	11	2¾ x 7⅝ x 9¾	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

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The Lafayette KT-200 Receiver

Continued from page 6

main filter capacitor. However, this kit appeared to have one of the original type capacitors in it. When wired according to the correction sheet, the second section of the filter capacitor was connected with reverse polarity and the first section was ungrounded. As a result, all of the voltages were low by a large amount and there was excessive hum. Indeed, this could lead to the demise of the filter capacitor if not found and corrected quickly. Reference to the terminal notation on the capacitor can clear up the problem.

A couple of omissions which will be caught quickly by the experienced kit builder but which might trip the novice are worthy of mention. One relates to the pilot lamp wiring. There are two pilot lamps—one for each tuning dial. The instructions direct the wiring only of the one on the bandspread dial while the second one is not mentioned or shown in any of the illustrations. Perhaps this is a change in the design which has not yet been worked into the manual. It is necessary only to run a couple of leads from the wired lamp socket to the other one in order to make both operate.

Another oversight appears in the rather detailed instructions for aligning the BFO. In the course of this procedure the manual fails to direct that the BFO be turned on with the front panel switch.

In the tabulation of voltages, the instructions fail to give directions for the setting of all of the front panel controls. This can lead to some readings which are perfectly normal but quite at variance with those given in the table. For example, it is obvious that the BFO must be turned off to obtain the readings given in the tabulation on the BFO tube. Likewise, some of the grid voltages will be different from those in the table, depending on whether the AVC is activated or not, and whether a signal is present or not.

Modifications

Two modifications suggest themselves as being worth consideration by those who may assemble one of these units in the future. One is to take advantage of the three unused prongs of the five-prong rear apron socket to bring out a power take-off for a Q-Multiplier, TR Switch, crystal calibrator, or other low-drain auxiliary station accessory. Connect one pin to ground, one to the 6.3 volt filament line, and one to the plate voltage from the output of the filter. It is a good idea to mark these on the chassis beside the socket so that when you want to use it, you can recall how you wired the socket without having to open the cabinet and trace the wiring.

The second modification relates to the 10 watt resistor used as part of the power supply filter (R21). This generates considerable heat and it is in rather close proximity to the oscillator coils and padders. Since the set was found to have a very substantial amount of drift for about the first 10 or 15 minutes of its operation from a cold start, it seemed prudent to move this resistor over to the side of the chassis away from the coils and nearer some of the ventilating holes. This move diminished the warm-up drift appreciably and made for more rapid stabilization.

The BFO in the particular unit tested failed to provide sufficient injection to allow for good SSB reception. It was necessary to increase the size of the small tabular capacitor which coupled the BFO output into the second detector. The 2.2 pF capacitor supplied was too small. A 10 pF disc ceramic gave more suitable injection level and an even larger one might be desirable. (Two pieces of hook-up wire twisted into a gimmick capacitor might serve as well.)

While the receiver is capable of good SSB reception, it must be observed that tuning in a sideband signal with the small BFO knob on the panel can be a bit tedious. A larger knob, or planetary reduction drive would be of some assistance.

Operation of the KT-200 during the limited time since its construction has left the impression that it is definitely a hot performer even on 10 meters where many single-conversion general coverage units with 455 kHz IFs fall down. No problem was encountered with images, no doubt due to the isolation and attenuation provided by the RF amplifier stage. Sensitivity is very good and selectivity is adequate, although the addition of a Q-Multiplier would be useful for operation in the crowded ham bands. After the warm-up drift previously discussed, the stability is excellent—good enough even to allow satisfactory reception of single sideband signals. Incidentally, as sort of a bonus, this receiver is an outstanding performer on the broadcast band.

In summary, the KT-200 appears to be an excellent value for a middle-priced general coverage receiver. It is worthy of serious consideration by anyone ready to graduate from the inexpensive five- or six-tube general coverage receivers, but not yet in a position to purchase one of the top-flight communications receivers. Or it might be useful as a second receiver to supplement your ham-band-only hearing aid. **RF**

Reprinted from 73 Magazine, *May 1961.*

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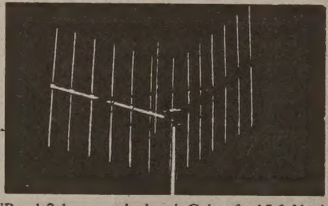

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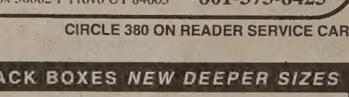

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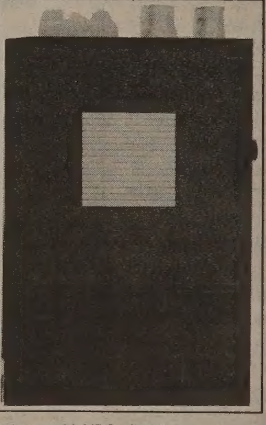

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RF review

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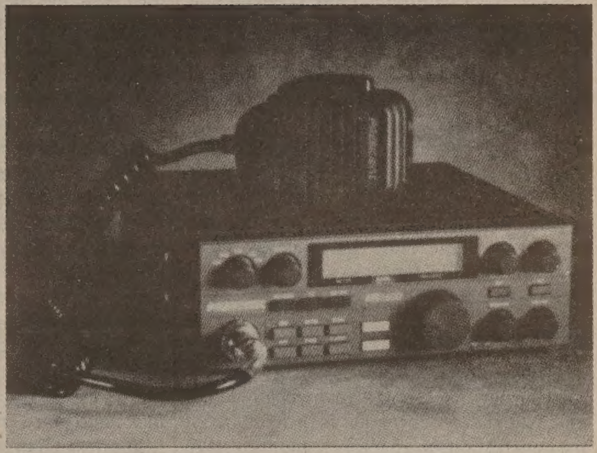
The Uniden HR-2600

A beauty of a mobile rig!

by Marc Stern WA1R



We have an amazing hobby. Every new contact is as exciting as the first, no matter how long ago that was. Take 10 meters, for instance. Just the other day 10 was open as I cruised along a road near my house. As I tuned around on my 10 meter rig I heard Cyprus, Malta, and Ireland. Not being one to let an opportunity go by, I called each station, and what do you know! They came back to me: Cyprus on the first call, Ireland on the first call, and Malta on the third. The amazing thing is that it was all done with 25 watts from Uniden's modest power level transceiver, the HR-2600, into a base-loaded, mag-mounted mobile antenna (Wilson's 1000).

The HR-2600 looks the same as its predecessor, the HR-2510. About the only way you can tell them apart is by the HR-2510 label on the older model and the RPT setting on the front panel of the HR-2600. That's it.

What are the improvements on the 2510? Read on to find out!

Major Changes

Table 1 shows what has been added to or eliminated from the HR-2510 to make the HR-2600. Let's look at each change briefly.

• Transmit beep: When the HR-2510 was first introduced it initiated a telltale annoying transmit beep whenever the beep button was pushed. I guess it was Uniden's way of trying to indicate an "over" signal for phone ops. This feature has been replaced on the 2600 by the repeater offset function.

• Public address: When the HR-2510 debuted, it had a public address capability. I guess you can tell its heritage, as most 11 meter rigs have that function, too (why, I can only guess). On the HR-2600, the PA function has been eliminated in favor of a real RIT switch.

• RIT control switch: When the HR-2510 debuted it was equipped with a continuously-tuned Receiver Incremental Tuning (RIT) circuit. The only problem was that unless you left it centered all the time, you couldn't really tell what the receive frequency was. There was also no indication of just how far away from your operating frequency the RIT had placed the 2510, and again, unless you left the RIT centered, you never really knew where you were. There was also no indication that the RIT was engaged at all times.

Several modifications were published to get around this problem, and Uniden responded. The addition of the RIT ON/OFF switch, in place of the PA switch, is an excellent change. The frequency display remains the same when the RIT is engaged, but you must physically engage the RIT control before it is activated.

Think about what this seemingly small change means. How many times do you think the owner of an older HR-2510 went to answer a CQ, only to find that the RIT had left the receive 2 kHz off the transmit frequency? Situations like this can be frustrating, especially if you're not "quick on the tune," so to speak. And, with 3 kHz bandwidth, it could become more than a little annoying on CW where most rigs use an 800 Hz or so offset. You could easily tune right through a CW signal and you never really could zero-beat it easily.

Now, however, the RIT is defeatable—you can use the VFO to tune critically, and then use the RIT to fine-tune after you've homed in. You can really zero beat signals now. However, the display still remains the same; there's no indication of received frequency change.

• Channelized operation: When the HR-2510 debuted, it was immediately apparent that it came from a world of channelized operation. Frankly, it was little more than an 11 meter rig with a few changes. Granted, they were necessary changes—RIT, FM, CW and the like—but basically, the HR-2510 was still a converted CB rig.

> *"I received audio reports that were uniformly good, and signal reports that positively astounded me (worst case 5 and 4, which isn't bad for a 25 watt rig and a wildly swaying 60" whip)."*

Because the heart of the circuitry was originally a CB radio, it is easy to see why the orientation of the HR-2510 is toward 10 kHz channel spacing. CB is limited to 40 channels on 11 meters with an arbitrary 10 kHz spacing. Thus, when you tune the HR-2510 with either the buttons of the up/down, standard mike or with the up/down keys on the front of the rig, you find it tunes through 50 channels that are evenly spaced every 10 kHz. The VFO dial is the only control that will tune in any way other than 10 kHz steps.

The lack of continuous tuning with either the push-buttons on the front of the rig, or on the mike, made using the HR-2510 less than easy, especially for mobile operation. The HR-2600 fixes this problem by allowing continuous tuning with either the mike push-buttons or the up/down buttons on the front of the rig. Again, this feature was sought after by HR-2510 users, as fixes for it were published soon after the older rig was introduced.

Note, by the way, that Uniden still slices the 10 meter band into four band segments: 28.000-28.499, 28.500-28.999, 29.000-24.999, and 29.500-29.699. I can't fathom the reasoning behind this breakdown, except that the band segments roughly coincide with the Novice-Tech segment (28.100-28.499), international SSB window (28.500-28.999), satellite links and AM (29.000-29.499), and the FM/repeater window (29.500-29.699).

• Repeater splits: When the HR-2510 was introduced, it was loudly applauded for its standard FM, but more than one writer/observer also noted the lack of repeater offsets. To operate on repeaters, if they weren't tone accessed to begin with, meant that you had to transmit on the input frequency, then turn the VFO dial until you were on the repeater's receive frequency. Or you could set the SPAN control—the control which tells the HR-2510/2600 series the tuning rate (100 Hz, 1 kHz or 10 kHz)—and then hit the "up" button on the mike or front panel 10 times. Either way, it was awkward. The HR-2600 fixes that with built-in repeater splits. Using the former beep button location, Uniden has implemented standard 100 kHz splits for repeater work, making the HR-2600 a pleasure to use on repeaters.

• CTCSS Tones: When the HR-2510 was introduced it lacked CTCSS tones, a feature many repeater operators have implemented. Given the crowded state of 10 meter repeater pairs and the fact that at the height of the sunspot cycle communications is worldwide, repeater operators have opted to use CTCSS tones to help keep their repeaters quiet.

A 10 meter repeater near my home uses CTCSS, and implementing this option opened up a new world of operating for me. And it was easy to do! I just followed the clearly-written instructions in the manual and flipped a couple of DIP switches. Suddenly, where I used to be limited to listening passively to the repeater, I could access it and use it. The CTCSS tones made a *big* improvement. Essentially, the rest of the 25 watt rig has remained unchanged. It is still a multimode rig that puts out 25 watts on CW and 25 watts PEP on SSB. When you run AM or FM, the output is 10 watts nominal.

The Good, the Bad, and the Ugly

If you look closely at the specs (Table 2), you'll see that the HR-2600 is a very capable rig. The worst case of sensitivity is 0.5 μV, which is within the realm of other rigs of this type and, in fact, within the realm of just about every rig on the market. With 0.25 μV sensitivity on CW and SSB, the HR-2600 is just about as sensitive as any rig I own, although figures in the 0.15 range are also common in the HF world. Still, we're talking about orders of magnitude in price and selectivity.

That's right, selectivity. The more sensitive a rig gets, the more selective it has to become, and the HR-2600 can't seem to cope with several signals in the tuning passband. It tries to hear all of them at once and it begins to ring a little. However, when I put my Autek audio filter in front of the speaker, the problem cleared up and I was easily able to pick out signals.

Overall, I was quite pleased with the HR-

Table 1. Uniden's Changes

HR-2510	HR-2600	Change
1. Transmit beep	No transmit beep	Beep gone
2. Public address (PA) function	No PA function	PA eliminated
3. Constant RIT	RIT control/switch	RIT can be disabled
4. Channelized operation; 10 kHz channels	No channelized operation	10 kHz channels gone continuous tune
5. No repeater splits	Repeater splits	RPT button added
6. No CTCSS tones	CTCSS tones	CTCSS tones added

2600. I received audio reports that were uniformly good, and signal reports that positively astounded me (worst case 5 and 4, which isn't bad for a 25 watt rig and a wildly swaying 60" whip). As I noted, the addition of the repeater splits, CTCSS, and a switch to disable the RIT were also godsends. They added greatly to my enjoyment of the HR-2600.

I still haven't figured out the exact function of the MIKE GAIN control because it narrows the audio bandpass and attenuates outgoing audio. Instead of MIKE GAIN, I think it should read "MIKE ATTEN." Uniden would be well-advised to think about adding a high/low power switch, or a speech processor switch, in its place.

One feature I like is the SPAN control. With a flick of the push-button, you can change the tuning rate from 10 kHz to 1 kHz-100 Hz. This rate takes effect on the VFO. You can easily QSY up 5 by pushing the SPAN button so that the small line that appears is under the 100 kHz place on the frequency readout. After that it just takes five clicks of the "up" button.

Documentation

The documentation has drastically improved. The manufacturer is actually beginning to understand that our market is different from the general consumer market, and they have included schematics. True, they are small, and in some cases you need a magnifier to trace a line or signal, but it's a start.

Another feature has remained the same but is still welcome: the large, finned heat sink. It looks like it could handle more than 25 watts, but I'm happy with the output. When 10's open, that's all you need.

I'm also pleased with Uniden's realization that the "President" series (the other name for the 2510/2600) was too easily modified by the "freebanders" who operate on 10.5 meters, and by other operators who wanted to operate on 11.5 meters, where the series could also tune. To cope with the problem, Uniden has potted up the areas you need to adjust, and has put warning signs all over the interior. There's also a warning in the manual that makes it clear that Uniden will turn over the name of any person modifying the "President" to operate outside its authorized band. The warning, a large insert in the documentation, easily falls out on the table as you unpack, and it's a color you can't miss.

Two features that have remained the same, which I really don't care for, are the accessory plug and the power jack. Uniden uses a 9-pin Molex-style connector for such functions as CW, external speaker, and internal speaker.

The method of hookup is about as kludgey as anything I've ever experienced. For example, imagine hooking up your CW key with a Molex-style connector with two wires just sort of drooping into the connector. Aesthetics aside (it looks tacky), it doesn't make sense. Why the manufacturer didn't include miniature jacks for the CW key and external speaker (or phones; it really doesn't matter) is beyond me. There are just too many little pieces of wire hanging off a single, plastic connector. It really isn't convenient to use, especially when you consider that it locks into place and you have to literally pry it apart to change back to the "standard" configuration which features the internal speaker jumpered to work. The power connector seems like a least-cost option, and would be improved by a better, more secure connector.

Still, the last two points are minor, especially if you intend to use the HR-2600 mainly for mobile phone use. In this role it shines brightly. I like it and it has joined my stable of mobile rigs. RF

Reprinted from the March 1990 issue of 73 Amateur Radio.

Table 2. HR-2600 Specifications

General	
Frequency Range	Band A28.0000-28.4999 MHz Band B28.5000-28.9999 MHz Band C29.0000-29.4999 MHz Band D29.5000-29.6999 MHz
Frequency Stability	+/-300 Hz Nominal (@25 degrees C, five minutes after power on)
Microphone	500 ohm Dynamic, PTT, UP/DOWN buttons
Speaker	8 ohm, 5 watts max.
Operating Modes	CW, USB, LSB, AM, FM
Display	Backlit LCD
Display Items	Freq., Band, Repeater Mode, Meter Mode, TX, VFO Span
Size	7.32"W x 10.35" D x 2.44" H
Weight	4 pounds, 3 ounces
Transmitter	
Output Power	CW, 25 watts USB/LSB 25 watts PEP AM/FM 10 watts nominal
Spurious Harmonic Emissions	-50 dB nominal, all modes
Carrier Suppression	-55 dB nominal, USB/LSB
Unwanted Sideband Suppression	-45 dB nominal, USB/LSB
Power Consumption (maximum modulation)	AM/FM 3 amps nominal USB/LSB 0.8 amps (no modulation) CW 5 amps (key down)
Power Consumption (maximum modulation)	AM/FM 3 amps nominal USB/LSB 5 amps nominal
Microphone input	1 mV nominal for 50% AM modulation
CW Key Voltage/Current	8 VDC, 10 mA
Receiver	
Sensitivity for 10 dB	AM 0.5 µV nominal
S/N	CW/USB/LSB 0.25 µV nominal
RF	Image Rejection Ratio 65 dB nominal
Power Consumption	500 mA nominal
Squelched Power Consumption, Maximum Audio	1000 mA nominal

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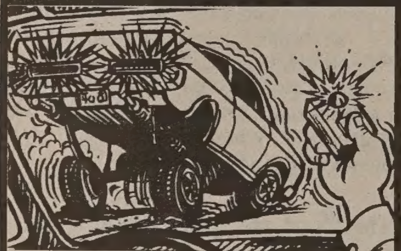

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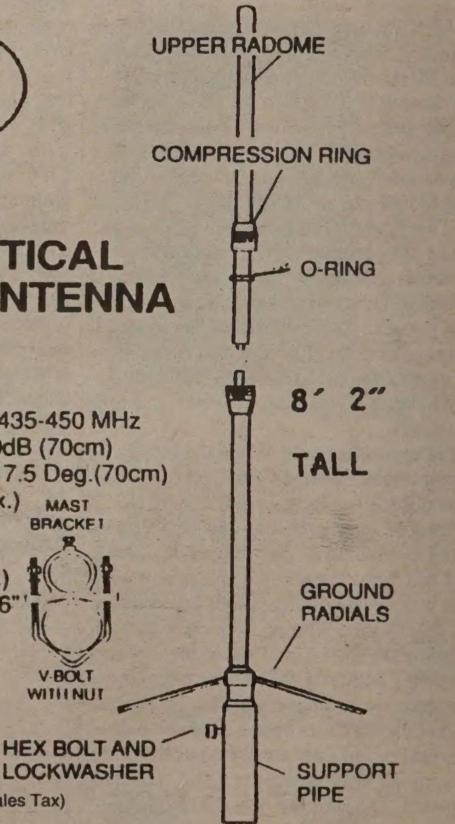
SPECIFICATIONS:
FREQUENCY: 144-148 MHz, 435-450 MHz
GAIN: 6.0dB (2m), 8.0dB (70cm)
BEAMWIDTH: 42 Deg. (2m), 17.5 Deg.(70cm)
POWER: 200 Watts (Max.)
IMPEDANCE: 50 ohms
VSWR: Less than 1.5:1
WIND RATING: 112 MPH (Max.)
MAST DIA.: 1-3/16" to 2-7/16"
LENGTH: 98.4"
WEIGHT: 2.6 lbs
CONNECTOR: UHF



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CIRCLE 196 ON READER SERVICE CARD

Who Really Invented Wireless?

The answer may surprise you.

by Robert C. Green W3RZD

Does the name Mahlon Loomis ring a bell? Well, perhaps it should.

As to what Mahlon Loomis did, the Congress of the United States, on September 20, 1965, expressed in a joint resolution what they believed. It read in part, "... Doctor Mahlon Loomis in being the first person to invent and demonstrate a system of wireless communication."

Just who was Dr. Mahlon Loomis? Very little is known about him. We do know that he was born in Oppenheim, New York, on July 21, 1826, and at the age of 22 he enrolled in dentistry school in Cleveland, Ohio. After completing school it is believed that he practiced dentistry in Cleveland for a while, and then went to Washington, D.C., to open a practice.

Loomis was an experimenter, interested mostly in electricity and its effects. At one time he tried to force plants to grow faster and more abundantly by discharging batteries through the earth around the roots. Another of his experiments dealt with recharging batteries with electricity gathered by kites, using wire for the strings.

Would Mahlon Loomis be considered the inventor of radio? He was certainly a contributor. But he was not the only inventor who helped to give birth to this modern technology.

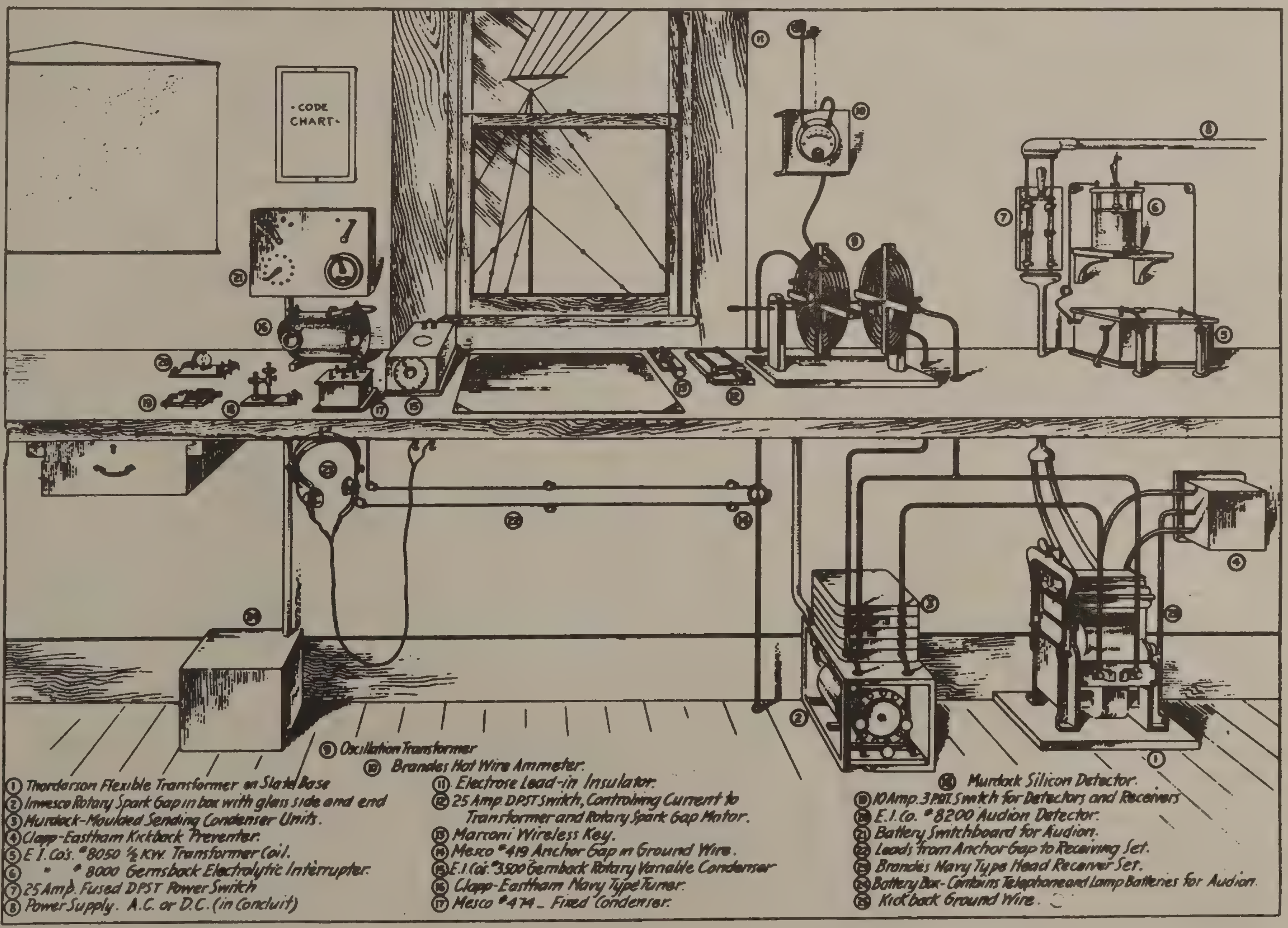
In 1843, Samuel Morse constructed a telegraph line between Washington, D.C., and Baltimore, MD—the first telegraph line in the world. Loomis showed extreme interest in the telegraph and learned all he could. He was even more intrigued when Morse proved that only one wire was needed between telegraph stations, if the ground was used as the second wire. This brought about some speculation on Loomis's part: He wondered that if the ground acted as one wire, why couldn't the sky act as the other wire? He had perhaps already learned something of this with his experiments in trying to recharge batteries.

In 1866, Loomis and an assistant, 18 miles apart on the tops of two mountains in West Virginia, proved that the sky could act as a wire. Each man attached 600 feet of wire to a kite and sent it aloft. Between the bottom of each wire and ground they connected a sensitive indicator of electric current called a galvanometer. When either man momentarily broke the ground connection, the meter at the other kite would indicate the make-break contact. After many demonstrations and frustrations, Loomis applied for and was granted a patent for a wireless system in 1872. He died at Terra Alta, West Virginia, in 1886, near the two mountains where he had conducted his experiments.

Loomis's attempts to communicate through the air were not forgotten. In many countries there were attempts to improve on Loomis experiments. In 1887 Heinrich Hertz of Germany proved that an arc generated at one coil would produce a smaller arc in another coil several feet away. Later, Hertz was able to detect the arc over distances of 30 to 40 feet. He proved also that the arc produced electromagnetic waves, and that the waves would pass through wood as well as the air.

Marconi

The first person to transmit wireless signals over greater distances was Guglielmo Marconi, who was born in Italy in 1874. While a teenager, Marconi began reading all he could of Loomis and others experimenting with electricity, but he was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especially interested in the work of Hertz.

It was one thing to send a signal generated by an arc, but it was another thing to receive it. When Marconi was 16 (and it was only three years after that Hertz proved he could detect an arc), a Frenchman, Edouard Branly, developed the coherer detector.

The coherer was a small glass tube filled with metal filings, and in the presence of an arc the filings would rearrange themselves and pass a current. However, the coherer would have to be jarred to dislodge the filings before another arc could be received. The coherer, in modern terms, was a very poor, one-shot, half-wave rectifier.

All of Marconi's early transmitting experiments were at his home, and all were over short distances. Probably while thinking about Loomis's kites, he made a discovery that changed wireless forever: He placed an antenna and ground at the sending and receiving ends of his equipment. The signal could now be picked up over a distance of several miles.

Marconi can also be credited with the introduction of using the telegraph key and Morse code in wireless. He also worked on the coherer by using different types of filings, and evacuating the air from the glass tube, making it more sensitive.

He offered his invention to the Italian Government, but was turned down. In 1896, at the age of 22, he went to England and there he was granted a patent. Apparently the word "radio" was devised by the British to replace the word "wireless."

One year later, he transmitted a message to a ship 18 miles at sea in a demonstration for the Royal Navy. In 1899, Marconi equipped three ships of the Navy with radio. It is possible that one of the ships so equipped was a lightship off the southeastern coast of England. If so, that ship can be credited with the first use of radio to save lives at sea. In March of that year, the steamer *Elbe* ran aground near the lightship. A distress call from the lightship enabled shore parties to rescue the passengers and crew of the *Elbe*.

In 1900 Marconi devised a system for tuning the arc and coherer, which he called Four Circuit Tuning. His biggest triumph occurred in 1901, on December 12th. On that day he sent a message across the Atlantic between England and Newfoundland. That message was short: just the letter S, three dots in Morse code.

Tesla

At the age of 28, Nikola Tesla came to this country from Croatia, arriving in 1884. He worked for Thomas Edison for a year, and later for Westinghouse. Tesla held numerous patents, many dealing with transmitting electrical power through the air so it could be used for lighting. When Tesla heard of Marconi's transatlantic message, he is reported as saying, "Let him continue. He is using 17 of my patents." (In 1943, the U.S. Supreme Court found that Tesla had in 1893 described in some of his patents the same processes and ideas that Marconi used in 1901.)

The arc transmitter developed its arc through two pieces of carbon, which gave a ragged tone and was not always consistent. Marconi saw the problem and invented the rotary spark gap to replace the arc. The rotary spark gap was a motor driven wheel that had equally numbered and spaced spikes around its rim, and the spark was made when an arc jumped between one or more wheel spikes to a stationary spike. The rotary spark gap produced an arc that was consistent and gave greater strength to the signal.

Batteries had been used for the high voltage necessary for the spark. However, due to the large number of batteries that were needed, they were soon replaced by motor-driven generators supplying 2,000 to 2,500 volts DC.

The early arc and spark gap transmitters operated in the 14 to 20 kilohertz frequency range, just above the audio frequencies. Because of the frequency, and the high power used, very large coils were necessary. Coil forms were huge wooden frames, some as large as two feet in diameter, and wound with tubing or heavy wire.

In 1902 Greenleaf Pichard, an American, discovered the silicon crystal detector while trying to improve the coherer. This led to the galena crystal which became popular as the detector used in thousands of crystal sets a few years later.

> ***"Probably while thinking about Loomis's kites, Marconi made a discovery that changed wireless forever."***

Even after Edison invented the light bulb, he still looked for ways to improve it. In one attempt he discovered what was to become known as the Edison effect: He detected a small flow of current between the filament and a metal plate he had placed inside the bulb.

Fleming

In England, Doctor Ambrose Fleming took note of the Edison effect and began further studies. Out of his work came the Fleming valve in 1904, the world's first radio tube. The tube had a metal sleeve that encircled the filament, which gathered more electrons than the flat plate Edison used. The Fleming valve was a diode, but it revolutionized the receiving of signals. It was now possible to eliminate the slow-working coherer as a detector.

Fleming connected the sleeve of his valve to a receiving antenna and placed the coil of a sensitive relay in the filament circuit which he connected to ground. Now whenever a signal was received the relay would close and operate a telegraph sounder. However, like any diode, the valve was only as good as the signal it received; the stronger the incoming signal the better it would work. The Fleming valve could detect but it could not amplify.

By this time it was known that radio waves were alternating current waves, and the frequencies in use were just a little higher than audio waves. In order to transmit audio, a source of radio waves four or five times higher in frequency would be required.

Fessenden

Working along these lines was Reginald Fessenden, a Canadian by birth, who had come to the United States and settled in Massachusetts. Fessenden had already transmitted voice over a distance of a mile in 1902, but the results were unsatisfactory. To obtain the higher frequency necessary, Fessenden, in 1906, ordered an alternator operating at 100 kilohertz from the General Electric Company. (A generator produces direct current, and an alternator produces alternating current.) The alternator was designed by Ernst Alexanderson of GE. Later, Alexanderson alternators were to become world-famous as code transmitters. After the alternator was finished it was delivered to Fessenden's laboratory at Brant Rock, Massachusetts.

On December 24, 1906, Fessenden placed an Edison Gramophone (phonograph) in front of several telephone microphones and broadcast music and voice. The music was on records, part of an opera by Handel and Christmas carols sung by a woman. The voice, probably Fessenden, requested that anyone hearing the broadcast please answer by mail. A number of letters were received, some from as far as 200 miles, from both land stations and ships. The broadcast lasted less than an hour, but it was the forerunner of things to come.

In less than a month after Fessenden's broadcast, Lee De Forest received a patent for the triode tube. The addition of a grid to the Fleming Valve meant that signals could now be amplified. Five years later, De Forest discovered that the triode could also be made to oscillate. The arc, spark, and alternator were doomed.

In 1909 Marconi shared the Nobel Prize in physics for his work in radio. In the same year the value of radio was proven when rescue ships heard the distress message sent by the sinking *Republic*. Radio again brought rescue ships when the *Titanic* sank in 1912. These two incidents lead the United States government to order that all large ships be equipped with radio.

It might be interesting to note that most of the later arc and spark transmitters were keyed in the antenna circuit. Once the arc or spark was generated it was allowed to remain on as it required a constant current to be stable. The antenna was not keyed directly, but through a relay that would short circuit a small coil wound around the tuning coil in the antenna circuit. When the small coil was shorted it changed the inductance of the tuning coil. Thus, when the key and relay were closed the antenna was tuned to frequency, and when the key and relay were open the tuning coil was detuned to a different frequency. The alternator was also keyed in a somewhat similar manner through a magnetic modulator that was like a transformer.

By 1917, communication companies, the military, and amateurs were beginning to use tube transmitters and tube receivers. However, the alternator would hang on for a few more years, especially the high power units used by the military. A lot of these alternators had an output of 200 kilowatts or more.

After World War I ended in 1918, radio started to make giant strides forward. For example: From just three broadcast stations in 1920, there were nearly 1,400 in 1924. When radio amateurs proved the value of shortwaves above 1,500 kilohertz, there was a general rush to these frequencies by all services, except the broadcast stations. Again, radio amateurs led the way.

Lee De Forest referred to himself as "The Father of Radio," and perhaps he was. The invention of the triode, out of the many inventions he had, was the stepping stone that put radio on the path where it is today. Radio had been born, and the infant grew, tended and loved by many.

Other Contributors

Besides those mentioned above, many others have had a hand in developing radio. Alessandro Volta, of Italy, invented the battery in 1774. Hans Christian Oersted, of Denmark, discovered there was a relationship between electricity and magnetism, in 1800. Andre Ampere of France, in 1820, developed the electrodynamic theory. Georg Ohm, a German, in 1827, discovered the basic relationship between voltage, current and resistance. His equations became Ohm's Law. Joseph Henry, from the United States, can be credited with the discovery in 1827, of self-inductance and the electromagnet. Michael Faraday, of England, in 1831, discovered mutual inductance and did further work on magnetism.

They say that success has many parents—but failure is an orphan. The invention of radio ranks among the major success stories of the modern age. Radio has created monumental changes in how people communicate, in how societies have developed, and in the way we live. As amateurs, perhaps we should recognize that the technology we take for granted today took a lot of creative experimenters a long time to create. RF

On the cover this month is a photograph of a vintage 1920s radio store, courtesy of the Antique Wireless Museum in Bloomfield, New York. It is not really a store; it is simply an exhibit.

The AWA Museum holds one of the largest collections of early apparatus—actual equipment associated with Marconi, DeForest, Armstrong, Edison, and other pioneers. A lot of this equipment is available for your inspection and a lot of it still works!

The museum's collection includes antique amateur radio equipment as well as the modern station W2AN. Visitors can listen to an old-fashioned cat's whisker radio, talk on 19th century telephones, see old shipboard wireless transmitters like those on the ill-fated Titanic, tune an antique Atwater Kent receiver, and see a Tesla spark coil in operation.

The AWA is a non-profit organization and admission to the AWA Museum is free. The museum is open from May 1st to October 31st, and attendants are always on hand to explain things to visitors. Bloomfield is located 25 miles southeast of Rochester, New York. For more information call (716) 657-7489 or (716) 657-6260.—Charlie WA1RZW

Home-Brew UHF/VHF Antenna

Build this high-performance dual-bander!

by Patrick Wong VE3RGW

I needed a low-profile dual-band antenna for my vehicle. I tried out a couple of factory-built products, but none of them met my expectations! I must point out that the above trials did not include designs longer than a half wavelength due to my own height clearance requirements. Most of the factory-built models served well on VHF but suffered high loss or serious fading in the UHF band. I finally worked out a home-brew model which completely out-performed all others in terms of efficiency, dimensions, and cost.

Test Results and Comparisons with Other Designs

I tested the antenna in different environments:

Passenger vehicle trunk mounting
High-roof vehicle (van) mounting
Base station mounting

Several other factory dual-band antennas were used for comparison, including:

19" whip with spring base
Cellular-like (NMO mount)
Multi-section whip (claimed 3.8 dB on VHF/6.4 dB on UHF)
Center-loaded quarter-wavelength whip

The results were evaluated in communication with far-away repeaters with weak return (S1) signal levels, accessed at QRP condition.

On the UHF band, this antenna is beaten by the multi-section design only. It failed to access the repeater and received it with only slight noise. Under the same situation, all other antennas failed the access test while the 19" whip and cellular-like design couldn't even pick up the repeater. By increasing transmit power to regain access to the system, the new antenna proved to be much cleaner on access and suffered fewer fading spots compared to the other three designs in the same class. It can always maintain stable contact. The signal from the repeater seldom fell below the squelch threshold with changes in the antenna's position.

Photo B. UV antenna, base-station mounting.

In the VHF band, this design is slightly weaker on direct simplex contact than the multi-section and the 19" whip. Not much difference was observed when making contact through repeaters. When used in locations with medium out-of-band interference (road junctions next to known high-power VHF paging stations) it seems to have a better rejection of interference. With this new antenna, the repeater's signal can still be heard, with noise, while with the multi-section whip and the 19" whip the receiver only got junk signals.

Generally speaking, this is a dual-band antenna with its best performance on UHF. It can satisfy the needs of most amateurs. If you always work in hot areas where out-of-band cross modulation is causing trouble to your reception, this antenna might even improve the selectivity slightly. If you always work in marginal signal areas and have to squeeze the last drop of energy from your system, this is not the best candidate.

Basic Design Theory

This antenna is just a quarter-wavelength resonator for both the UHF and the VHF bands. It provides no *gain* compared to other multi-section designs, yet it has the advantage of better stability against surrounding influences (e.g. different mounting methods, unexpected reflection by surrounding objects, difference in stray capacitance between test bench and operating field).

The antenna consists of two sections. The lower section is a conductor cut to resonance on the UHF band. The upper section is a coil which serves two purposes. For the UHF band, this coil is an RFC (radio frequency choke). It blocks UHF energy from flowing through the upper section. For the VHF band, this coil enhances the inductance provided by the lower section. The resultant inductor, together with the surrounding stray capacitance, forms a VHF-resonant circuit and, in essence, becomes the VHF antenna.

To get a better understanding of the tune-up procedure, it will be helpful to review some basic rules about antennas:

Rule 1. Antennas are LC circuits. The LC components control their resonant (operating) frequency. The inductive component is formed by the metal conductor of the antenna's body, while the capacitive component refers to stray capacitance between the antenna body and its surrounding grounded conductor.

Rule 2. Increasing either the L or the C component can lower the resonant frequency, while reducing them causes the opposite effect. The inductor can be increased by adding physical length to the antenna element or by constructing it as a coiled structure. Capacitance can be increased by using a larger surface area on the antenna body, by adding a capacitor hat, or by reducing the physical clearance between the inductive section and ground. In this case, we mainly alter the inductive section of the antenna to achieve tuning by cutting the length of the conductor and by changing the length of the coil structure.

Mechanical Structure and Material Consideration

Figure 1 shows two possible structures for this antenna: Model A is the fixed style and model B is VHF-adjustable.

The lowest section of the antenna is a PL-259 plug, the center pin of which is soldered to a 2mm-diameter copper rod. I got this copper rod from core conductor of RG-8U coaxial cable. It should create an exposed section (clear from the metal shield of the PL-259 plug) of about 135mm. (More detail will be discussed in the tune-up section.) This copper rod is hidden inside a tube which acts as the coil form for the upper section. To avoid absorption of RF energy emitted from the antenna, the material for this tube must be carefully selected. I used PVC faucet tube for this part. They are polybutylene, gray PVC plastic; cheap and easily obtainable from most hardware stores. You can use any other tubes, provided their external diameter can fit into the barrel of the PL-259 plug and they do not absorb radio waves.

We can use a microwave oven to check if a certain material will absorb RF energy. Material placed inside an operating microwave oven will generate heat if it absorbs radio waves. Place the material under test inside the microwave oven along with a cup of water (for safety). Heat for, say, one to two minutes, then check the surface temperature of the object. If the material stays cool compared to the cup of water, we can assume that it does not absorb radio waves and will be suitable for the job.

A small hole (1mm) is drilled on the tube just beside the tip of the UHF section. A piece of laminated copper wire (#22 AWG) is soldered to the tip of the UHF section and leads to the outside of the tube through this hole. The rest of this wire is wound on the upper part of the tube and forms the VHF section.

Photo A. UV antenna, vehicle mounting.

After proper tuning is completed, the whole antenna is sealed within a piece of heat-shrink coating down to the neck of the PL-259 plug. A rubber cap can be placed on top of the antenna in order to prevent water from entering the tube.

Construction Procedure and Tune-Up

Cut out a piece of 2mm copper rod. Let's start with a length of about 160mm. That should cover future cutting jobs and the

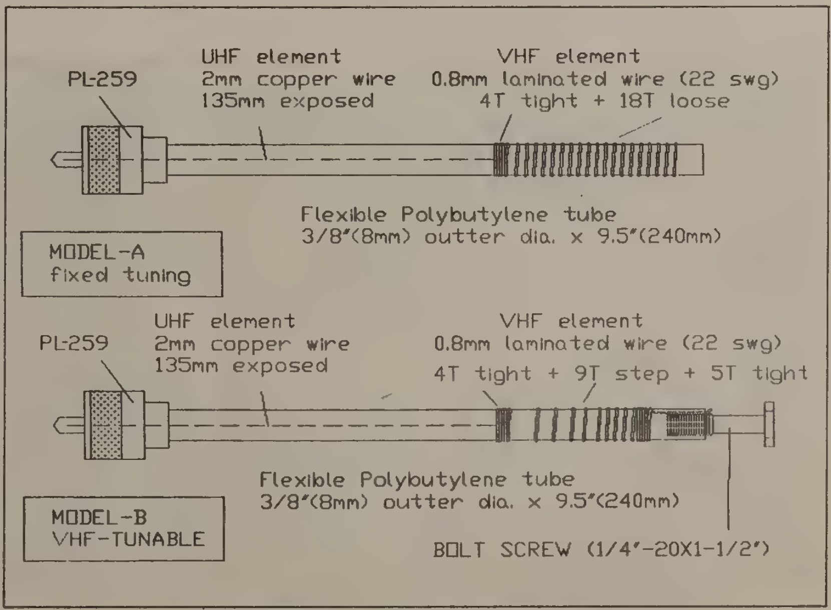
PL-259
UHF element
2mm copper wire
135mm exposed
VHF element
0.8mm laminated wire (22 swg)
4T tight + 18T loose
Flexible Polybutylene tube
3/8"(8mm) outter dia. x 9.5"(240mm)
MODEL-A
fixed tuning
PL-259
UHF element
2mm copper wire
135mm exposed
VHF element
0.8mm laminated wire (22 swg)
4T tight + 9T step + 5T tight
Flexible Polybutylene tube
3/8"(8mm) outter dia. x 9.5"(240mm)
MODEL-B
VHF-TUNABLE
BOLT SCREW (1/4"-20X1-1/2")

Figure 1. Cross-section diagram.

length hidden inside the PL-259 barrel which is not counted for radio emission. Insert it into the center pin of the PL-259 plug and make a smooth soldering at the tip of the pin. We now have a UHF antenna.

Before attempting to tune it, prepare two pieces of 2mm copper rods, 140mm and 500mm respectively. They will serve as the temporary ground planes for the UHF and VHF tests.

Figure 2 shows the tuning procedure. By using a reflectometer (SWR meter), check out the reflected power from this simple antenna when UHF power is fed. Cut the length of this section slowly (in 2mm to 3mm steps) and observe changes on reflected power at the lower end of the target frequency band. Without attaching a good ground plane it is impossible to obtain zero reflect status, so just go for the lowest possible value. Using the low-end frequency for testing is a safety precaution that prevents you from over-cutting the antenna without notice. After you feel satisfied with the cutting progress and have slightly over-cut the rod (reflected power increases again upon further cutting), change the test frequency to the middle of the operating band and proceed, cutting carefully. Once reflect power has increased again (indicating a slight over-cut), pick up the 140mm section prepared earlier and touch it to the PL-259 plug of this antenna. You should see the reflected power immediately drop lower, or even to a 1:1 value. This confirms that the section is properly cut and is ready.

Cut out a piece of faucet tube (240mm in length). Insert it into the barrel of the PL-259 plug. Make a mark on the tube where it just clears the PL-259 barrel. Remove the tube and put it side by side with the UHF antenna while aligning the mark with the top of the PL-259 plug. Make another level mark for the tip position of the UHF section. Drill a 1mm hole on the tube at that mark.

Prepare a piece of 1-meter-long #22 AWG laminated wire. Push it through the above-mentioned hole and force it to run through the lower section of the tube until it comes out of the bottom. Solder this wire to the tip of the UHF section and pull the wire back into the tube; that will bring the UHF section into the tube as well. Pull out any excess wire inside the tube until the tube is tightly inside the PL-259 barrel again.

Wind the laminated wire on the tube for 22 turns. These turns should be in the pattern shown in Figure 1. The first four turns, which form the RFC for the UHF band, must be tight. The later 18 turns should be interleaved and evenly spread along until they reach the end of the tube. That should make a coil approximately 105mm long.

Place the antenna on the reflectometer again and recheck the SWR or reflected status on the UHF band. There should be no change compared to earlier test results. Change the frequency to the lower end of the target VHF band and repeat the test. Tune the VHF response of the antenna by altering the length and pitch of the 18-turn section. Generally speaking, start with evenly distributed pitch and try to control the resonant frequency with the coil length. If that doesn't work, try to rearrange the pitch unevenly—tighter pitch near the top and looser pitch near the bottom. Such treatment can further lower the operating frequency.

Like tuning the UHF band, go for the lowest possible reflect on the middle spot of your target band and confirm proper tuning by adding a VHF ground plane (a 500mm long copper rod). Once both bands are confirmed to be in tune, seal and secure the whole antenna with heat-shrink tube. The antenna is now ready for mobile vehicle use.

If you want future tuning to be possible in order to match different field environments, you can try model B, the VHF-tunable configuration. In that case, another 1mm hole should be drilled on the tube near the top portion of the coil. The #22 AWG wire should be directed back into the inner side of the tube. Form a section of contact wire 10mm long at the top end of tube. Screw in a 1/4" metal bolt to fill up the tube. Its pitch should bite through the laminated surface of the #22 AWG wire and make a solid contact with the wire. The bolt will become an extension of the coil and by adjusting the bolt length (in/out, or even changing the length of the bolt) the VHF resonant point can be adjusted.

> *"Like tuning the UHF band, go for the lowest possible reflect on the middle spot of your target band and confirm proper tuning by adding a VHF ground plane."*

Conversion for Base Station Application

This antenna can also be used at base station configuration. The trick is to provide a sufficient ground plane system in order to form the essential stray capacitance for proper tuning. Figure 3 shows a simple dual-band ground-plane design and corresponding mounting for the base station. This mount can also be used with other UHF/-VHF mobile antenna designs (as long as they use PL-259 base connector). It makes a very good test bench antenna, if you need to compare efficiency between two mobile antennas, or just want to convert another mobile dual-band antenna for base station application.

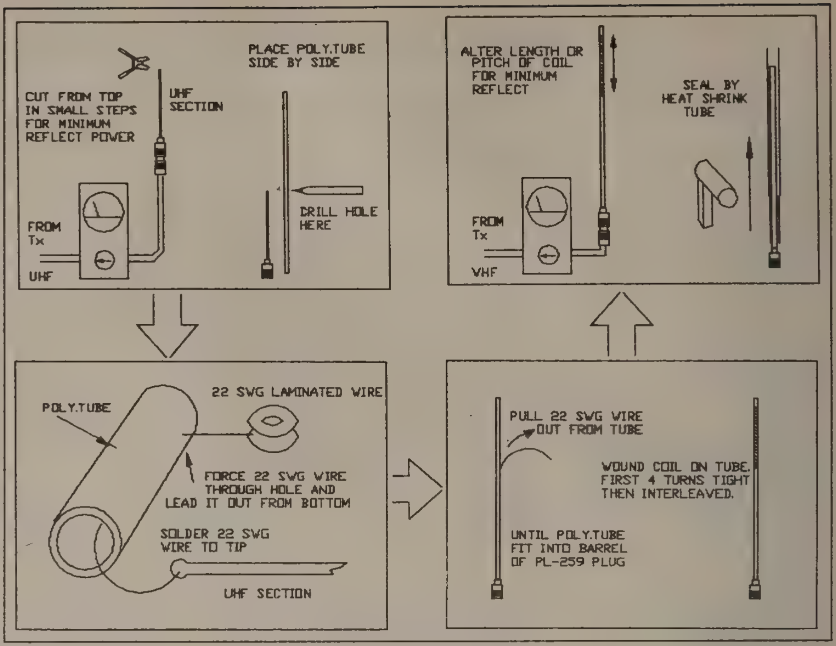
PLACE POLY.TUBE SIDE BY SIDE
CUT FROM TOP IN SMALL STEPS FOR MINIMUM REFLECT POWER
UHF SECTION
DRILL HOLE HERE
FROM Tx
UHF
ALTER LENGTH OR PITCH OF COIL FOR MINIMUM REFLECT
SEAL BY HEAT SHRINK TUBE
FROM Tx
VHF
POLY.TUBE
22 SWG LAMINATED WIRE
FORCE 22 SWG WIRE THROUGH HOLE AND LEAD IT OUT FROM BOTTOM
SOLDER 22 SWG WIRE TO TIP
UHF SECTION
PULL 22 SWG WIRE OUT FROM TUBE
WOUND COIL ON TUBE. FIRST 4 TURNS TIGHT THEN INTERLEAVED.
UNTIL POLY.TUBE FIT INTO BARREL OF PL-259 PLUG

Figure 2. Tune-up procedure.

The materials for this mount are all easily obtainable pipes and sockets used in electric power installation. We need a piece of electric conduit (metal pipe for protection of electric cable). The length is not critical; say, 20" will be fine. It should be 0.5" in diameter (these pipes are measured by inner diameter). Also find also the EMT connector (set-screw type) for the same family and put them on both ends of the conduit. The reason for using this dimension is that the inner diameter of such an EMT connector will perfectly fit a SO-239 socket (UHF female bulkhead receptacle solder type). You can tap threads on the inner wall of the EMT connector so that the SO-239 can be screwed in. I used a short cut: Just hammer the SO-239 into the connector. The only weakness of this method is that the socket cannot be removed easily or frequently. Everything must be done at the first move; nothing can be repeated for correction.

Putting two SO-239 sockets on each end of the conduit and connecting them inside the pipe forms a female-to-female adapter. The upper socket is for mounting of the antenna; the lower one is for connecting the feedline. The length of the conduit serves another purpose—it makes it possible to easily mount the whole antenna on another vertical pole using two hose-clamps.

We also need a piece of 4" round-pan (the top cover for circular power junction boxes). It provides a flat platform where the ground-plane elements can be mounted. The ground-plane elements are made of threaded stainless steel rods (size 10-24). Holes at 60 degree separation are drilled on the vertical edge of the round-pan, then the threaded rods can be mounted through these holes with two nuts (inside and outside the round-pan's edge).

The ground-plane's element lengths control resonant frequency. Different materials need different lengths to achieve

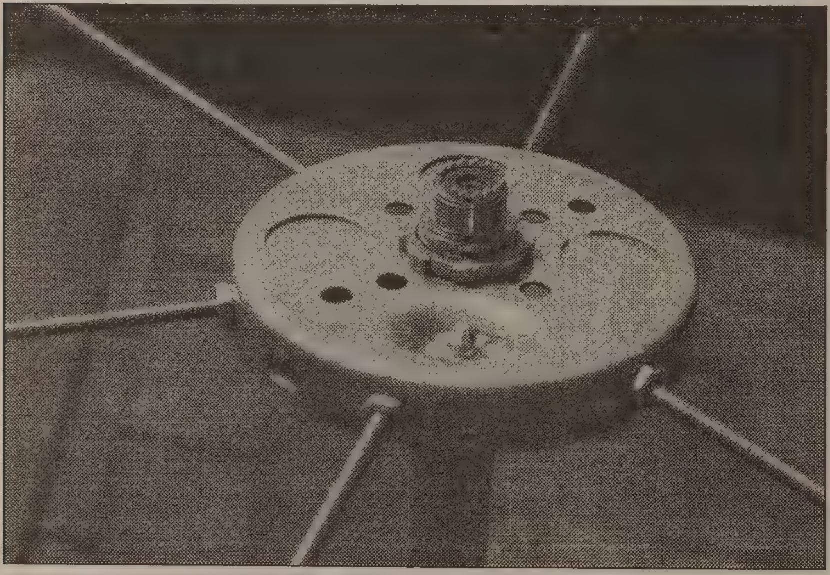

Photo C. Top view on base-station mount.

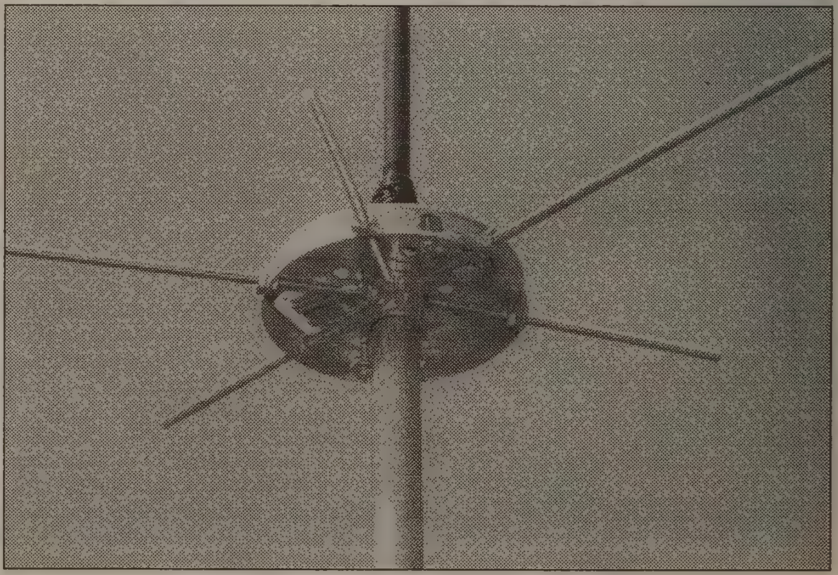

Photo D. Bottom view of base-station mount.

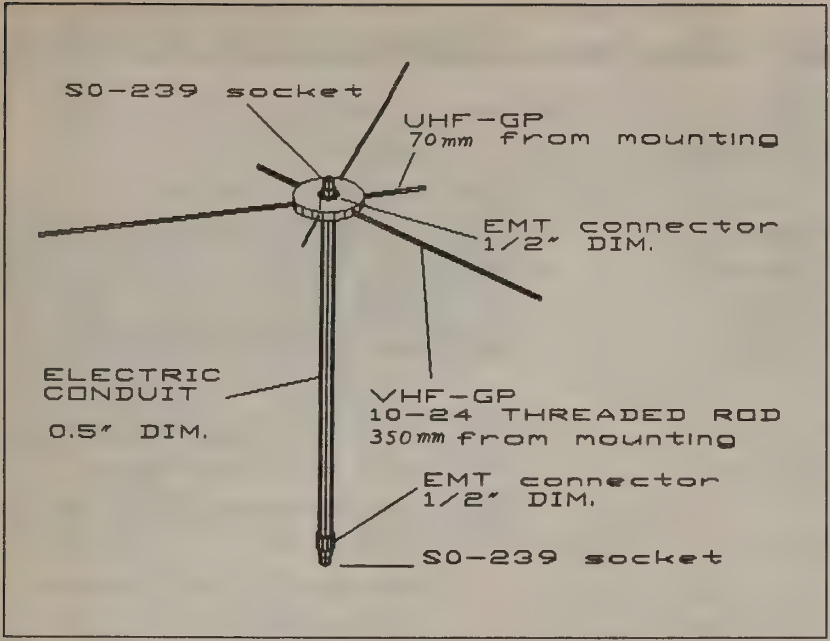

Figure 3. Ground-plane mount.

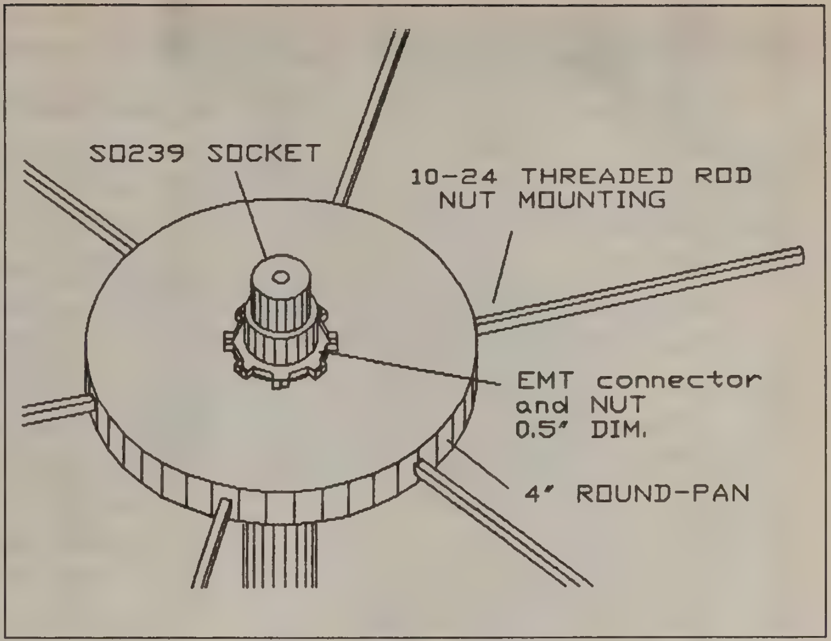

Figure 4. Close-up of mount.

resonance. The values 135mm at UHF and 500mm at VHF mentioned earlier are only good for copper conductor. For steel, the length will be different. This, together with having these rods mounted 2" away from the RF socket, will make their dimensions much shorter. Tests indicated that the UHF ground elements in this design are best at a length of 70mm, VHF elements at 350mm. (This length refers to the rod's length between the tip and the mounting point at the round-pan.) Since these rods are mounted with two nuts, their effective length can be adjusted. To play safely, the rods should be cut with 30mm of extra length. That comes out as 100mm for UHF and 380mm for VHF. The adjustment procedure for their final length will be discussed later.

The SO-239 connectors have to be connected inside the conduit. I made a mistake at the beginning—I felt that since both sockets were tightly hammered and in good contact with the pipe, their ground points should connect nicely. I used only single-core wire to connect their center pins, rather then using coaxial cable to join them. But I forgot one thing: The two EMT connectors were secured on the metal pipe with only two set screws! That is not a good contact for radio waves. I was surprised by the test results of such a prototype—an SWR reading of nearly 1.8:1, even with a proper 50 ohm dummy load termination. After modifying the connection with standard RG-58AU cable, the SWR for this section normalized to 1:1.

Drill six holes on the edge of the 4" round-pan and punch out the center hole on the top surface. Mount the round-pan on the upper EMT connector and secure it with the nut which comes with the connector. Cut threaded rods to the proper lengths (three at 100mm, three at 380mm) and have them mounted on round-pan in an alternating pattern; one UHF element followed by a VHF element, then vice versa.

Construction of the mount is now almost finished (and awaiting final tune-up). It is not a bad idea to paint the whole thing for protection against water damage in the future. Try to do it after all the ground rods are set. We need good metal contact surface between the round-pan and the rods.

Tuning the ground rods is similar to tuning the main element: The longer the length, the lower the resonance frequency. Since we have three rods for each band, we can set one rod on the lower frequency limit, one on high limit, and one for the center spot. This will create a flatter response of the antenna in the entire operating spectrum. Always remember to work on one rod at a time (with the other five removed). Set up one test frequency and alter the rod's length for minimum reflected power, then mark the length and change for another rod with another test frequency. Put them back onto the round-pan with the proper tested length after all key spots (three for VHF and three for UHF) are checked out.

Reflection from near by objects can distort the above measurement results. These tests must therefore be done in open space; try to obtain clearance of at least 5 meters from any objects which might cause reflection. Always try to use high-quality feedlines to avoid creation of fake images of low reflection when reflected power is absorbed.

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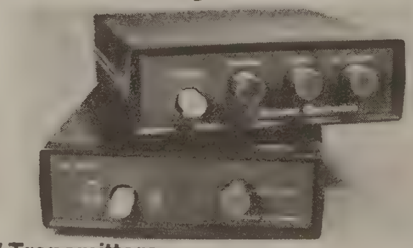

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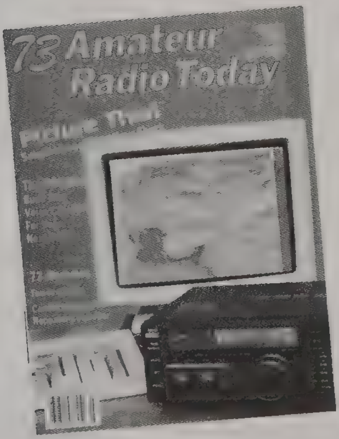

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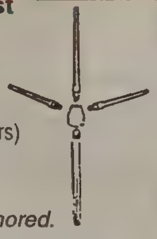

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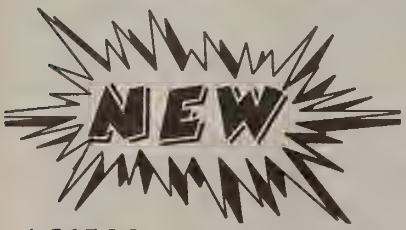

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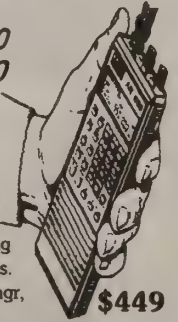

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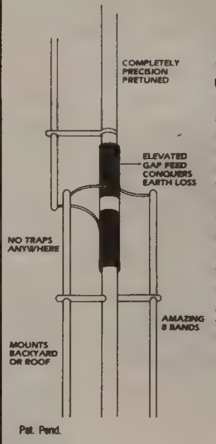

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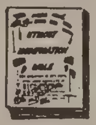

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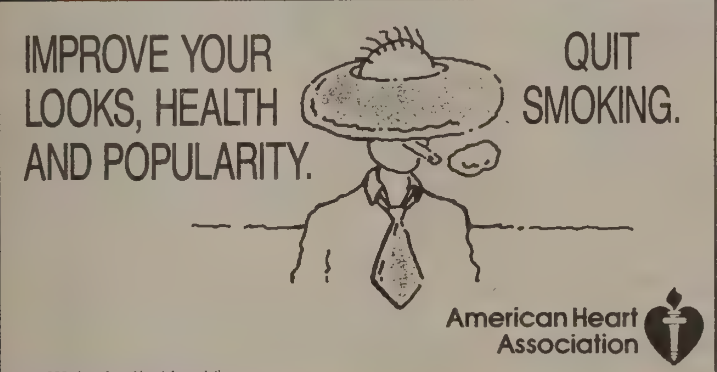
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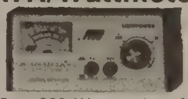

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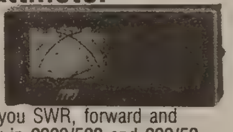

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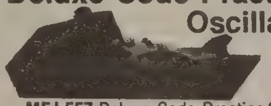

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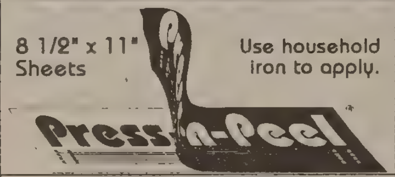
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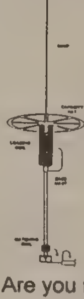

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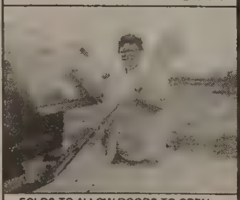

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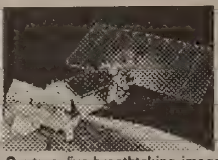

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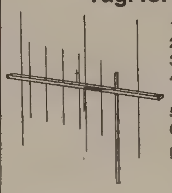

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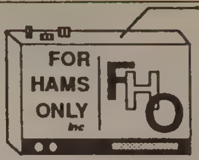

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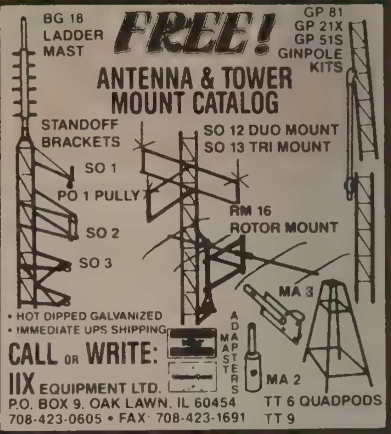

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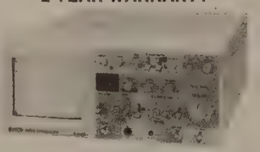

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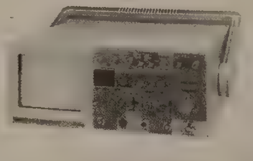

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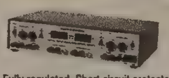

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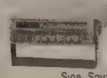

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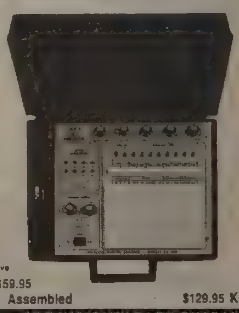

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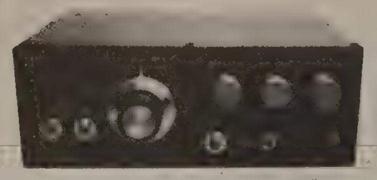

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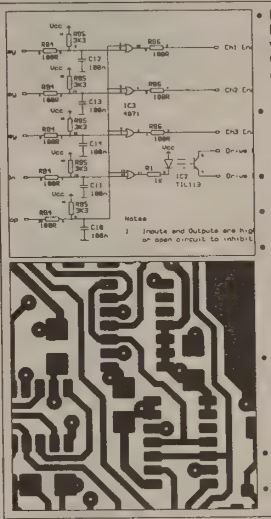

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CIRCLE 105 ON READER SERVICE CARD

the tech side

by Michael Jay Geier KB1UM

Perfection

I've just spent over three hours trying to align a fixer-upper cassette deck I bought at the last hamfest. It's an auto-reverse machine and, no matter what I do, I can't get the tape to track perfectly straight across the head in both directions. If I get it aligned for good sound in the forward direction, it's lousy in reverse. If I set it up for good reverse operation, then it's the pits in forward. Why am I bringing this up in a ham magazine? Well, the whole frustrating endeavor has started me thinking about perfection, tolerances, and what's acceptable and what's not.

I can't count the number of times I've heard hams discussing their equipment and antennas and lamenting that they're not as ideal as desired. Have you ever heard someone complain about a 1.2:1 SWR? I've heard people bemoan such a figure and vow to "get that darned SWR down to 1:1." Does anybody really think it will make a difference? Apparently so.

The Diddler

Remember that Kenny Rogers song called "The Gambler," wherein the title character suggests that the best any gambler can do in the long run is to break even? Sometimes it feels like diddling with the adjustments in electronic gear is much the same way—if you're lucky, you might just get it back to where it was when you started! Is it really possible to improve on the alignment of your gear? Is it a good idea? And, as I keep asking myself as I glare at that stupid cassette deck, is it worth it?

Maybe

Sometimes yes, sometimes no. Truthfully, I have seen some remarkably poor factory alignment on some pretty expensive, sophisticated gear. In the early days, many VCRs were adjusted so badly they wouldn't play another machine's tapes. And I've *never* seen two cassette decks that ran at the same speed; many vary by as much as five percent, which is very audibly noticeable. There's no excuse for that, but, to be fair, manufacturers have to set some limit on how carefully they set up their products. Nobody can afford to diddle that last ounce of performance from hundreds of thousands of machines as they come down the assembly line. So, it really is possible sometimes to get noticeable improvement from a device through proper alignment. Beware, though: It can be very hard to improve on the original, factory job. And, like that gambler, you just may lose, winding up with less than you had before. Heck, you might even mess the thing up so badly that you have to send it in for repair, and let me tell you, service techs like nothing less than undoing somebody else's mess. Your bill will reflect their annoyance.

> *"The most important tool is knowledge. Do you understand how the rig works, and are you sure what you're planning to tweak is, indeed, at the root of the trouble?"*

Before you go tearing into your rig to adjust it, be darned sure the "problem" or perceived lack of performance really is being caused by misalignment. Especially when you're new at the game, it seems tempting to attribute nearly any problem to an adjustment. There's a rule of thumb for that: If something very gradually changes, or it never was right to begin with, and especially if the unit basically works properly but just isn't quite perfect, then, and only then, it *might* require adjustment. But, if there's a sudden loss of, or change in, the performance, or the thing doesn't work at all, or it's so far out of whack you can't really use it, almost certainly something has gone bad, and attempts at alignment will only make things much worse. You *cannot* align around bad parts! Well, now and then it may seem to work, but it will always come back and bite you in an embarrassing spot sometime in the future, I promise. Now and then, though, you do have to align around a *good* part. Specifically, when you replace a bad part with a new one, you sometimes have to realign the circuit it came from. A good example would be the replacement of a transistor in a non-crystal oscillator. Very likely, you'd have to reset the oscillator's frequency, because no two transistors have exactly the same capacitance, so the frequency probably would have changed.

Good Enough?

Before you decide to go in and tweak something, ask yourself: Is this thing really so far off that it's worth the trouble and risk? I don't know about you, but I sure wouldn't go up on the roof to "correct" a 1.2:1 SWR! Nobody will be able to tell the difference anyway. And, if a frequency counter says my walkie is 500 Hz off frequency, I'm not gonna open it up and attempt to get it exactly on, right down to the last cycle. Heck, the frequency counter could be off by that much! This brings up the issue of tolerance. Yours, yes, for the amount of deviance from exactly what you want. But I'm referring to specified tolerances in the equipment. A walkie that's 500 Hz off at a frequency of 146 MHz is probably well within its design limits, and any attempt to correct the "error" will be in vain, because it'll drift more than that as the temperature changes, anyway. But what if the thing really is off enough to cause trouble? If your walkie is 3 kHz off, you're gonna sound pretty lousy through the local repeater. In that case, it really is worth digging in and making it right.

Sometimes, reality lies in between. Perhaps your rig works well enough to use, but something's far enough off that it really bugs you. If you think it's so bad that anyone would be bothered by it, consider sending it in for adjustment if it's still under warranty. But don't bother sending anything in unless the problem is fairly obvious. What's annoying to you may very well be within allowable tolerances, and most technicians wouldn't consider trying to tweak something to absolute perfection when it already works OK anyway; you'll probably get the unit back unchanged, and you may even get a bill. Of course, if the rig is out of warranty, you're on your own.

T Minus 10 . . .

Before you blast off into the unknown, make sure you have the proper tools to do the job. The most important tool is knowledge. Do you understand how the rig works, and are you sure what you're planning to tweak is, indeed, at the root of the trouble? In a complicated piece of gear, it often is possible to balance a problem by misadjusting something else! On extremely rare occasions, that's the right thing to do. Usually, though, it's a disaster. Sure, your problem may go away, but something else will misbehave as a result of the misadjustment. A lot of thought goes into the design of today's electronics, and the pieces of the puzzle fit together pretty tightly. Change the shape of one and you never know what the results might be. So, study the schematic, the block diagram, or any other data you may have, in order to further your understanding of the attempted procedure. And *never* do an adjustment a friend told you to do unless you understand what it is and why it works; just because it worked for him doesn't mean your radio needs the same change.

Once you're sure you know what you need to do, take a look at the tools and test equipment required for the procedure. You wouldn't want a surgeon to operate on you with a screwdriver, would you? By the same token, you normally can't adjust something that calls for a dual-trace, delayed-sweep oscilloscope if all you have is a voltmeter!

Actually, once in awhile you can. If you really understand the circuit, sometimes you can find direct effects of the adjustment and observe those instead of the recommended ones. The big danger here is that some things which look like direct effects actually also depend on *other* adjustments as well as the one you're doing, making the results deceiving. That's exactly how people wind up balancing one misadjustment with another and making a big mess.

Going First Class

The first-class way to do adjustments is with the service manual. Obviously, if all you're doing is setting a voltage regulator, and you know the required voltage, you don't need to spend for the manual. But, if you're aligning IF stages, a frequency synthesizer, or something like that, the manual is essential. In addition to showing you the adjustment points and desired results, most manuals also give you alignment steps in a specific order. Doing the procedures in order goes a long way in helping to avoid the tail-chasing syndrome of multiple misalignment.

Back in Coach

But what if you can't get the manual, or its price is so high it just isn't worth it? In that case, take another look at the circuit and try to deduce which adjustments are independent variables and which depend on other adjustments. For instance, a voltage regulator or a crystal oscillator's fine frequency trimmer would likely be independent; although their adjustment will affect other circuits, nothing else probably will affect *them.* On the other hand, an FM discriminator (detector) may seem off if the incoming IF signal is off-frequency, but the real problem is up the line in a local oscillator. So, the discriminator is a dependent variable, because its apparent alignment actually depends on the incoming frequency. Always check the independent variables before you go changing a dependent one.

Finally, it really pays to let any piece of gear warm up for a while before you start adjusting it. Even crystal oscillators drift a little with temperature. A half-hour ought to do it.

Well, I hope this little trek through the world of adjustments will help you avoid some of the pitfalls inherent in tweaking complex gear. Sometimes, no matter how hard you try, you still get caught—that cassette deck remains in pieces on my bench, and I'm starting to think I'm missing something. With that in mind, here's a final proverb (OK, I made it up, but it *sounds* like a proverb): When the pieces of a puzzle just won't add up, chances are there's a piece missing!

73 and see you all next time, from KB1UM. RF

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radio magic

by Michael Bryce WB8VGE

More Hidden Antennas

One of the most popular topics I've covered in the past is hidden antennas. For hams living in condos, mobile homes, or in areas in which no outside antennas are allowed, we'll look at some more ways to get on the air. All without being noticed by your neighbors.

The Hidden Spouting Dipole

Here is an idea that's really quite different: a full-size horizontal dipole hidden in the spouting! In this case, the spouting must be plastic, a common building material in newer homes and apartments.

Here's how you accomplish this feat. First, you need to know how long the spouting is. This length will determine the size of your dipole. If need be, you can add some traps to shorten the dipole. Secure a block of treated lumber on the ends of the spouting. You can use wood screws, industrial waterproof glue, or small nails. Be sure you don't cover up the downspouts. You don't want to have the rainwater back up and cause damage to the structure.

With a screw eye attached firmly into the middle of the block, attach one end of your dipole. The other end requires the same setup. Now, connect the dipole between the two ends, but pull it tight between the blocks. You want the dipole to be suspended in the middle of the spouting, held up by the wooden blocks and screw eyes. If need be, you can add some small wooden or plastic supports to keep the wire from sagging in the middle.

The center feed point connects in the usual manner. But, and this is very important, the feed point must be made completely waterproof! So dig out the RTV, coax seal and lots of tape because you don't want water to find its way into your coax and down into your shack.

By using RG/58U coax, you can route this feedline over the roof, or you can run it down the spouting to your window. Try to fasten the coax to the roof via the poop pipe vents or chimney. Don't nail it into the roof!

Use common sense when working up high. If you have a two-story house or apartment, a ladder would be safer than laying on the roof near the edge of the building. And, of course, keep a constant eye open for TVI when you're on the air.

As farfetched as this installation sounds, it really does work. Just remember: It won't work with metal spouting.

Commercial Hidden Antennas

If you have the money, there are many ways to get on the air using commercial antennas that may be hidden. And some are simple enough to take down when you're not operating.

One of the most popular setups today is the R5 and R7 by Cushcraft (1-603-627-7877). While they aren't antennas you can hide, they operate without the need for ground radials. The smaller of the two, the R5, looks like a large CB ground-plane antenna. It's 17 feet high. You can mount the R5 to your chimney without causing problems. The R5 will give you coverage from 10, 12, 15, 17, and 20 meters. I happen to use one of these antennas and can say it works quite well. It's no monoband beam up 80 feet in the air, but it will produce many QSOs for you.

> ***"Operating VHF and UHF is a bit easier because the antennas are much smaller. A mag-mount 5/8-wave atop a file cabinet will work surprisingly well. A 1/4-wave mag-mount on top of the refrigerator works great!"***

The R7, the bigger brother, adds the 30 and 40 meter bands. It's longer, 22.5 feet, and just about doubles the wind loading of the R5. Your chimney should be in good condition to hold the R7 in a windy area. Both antennas are rated at 1,800 watts PEP.

Cushcraft also carries several different types of regular, radial-required, vertical antennas. Look for their models AV3 and AV5.

Advanced Electronic Applications (1-800-432-8873) has the new IsoLoop 10-30 HF antenna designed for antenna-restricted locations. Its small size and compactness make the IsoLoop very attractive for your apartment, condo, or anywhere zoning restrictions for antennas apply. The loop is only 35 inches in diameter. Check out the reviews in *73 Amateur Radio Today* for actual hands-on use of the IsoLoop. I can tell you, it is a bit hard to tune at first, but once you catch on, there's nothing to it. The IsoLoop covers 10 to 30 MHz.

MFJ also carries several antennas for restricted locations. In fact, they too sell a half wave vertical antenna that requires no radials and a Super Hi-Q Loop antenna. I've never used either one from MFJ. Contact MFJ at 1-800-647-1800 for a full line catalog.

If you work mostly 10 meters, then look at the A99 by Solarcon antennas. The A99 is a half-wave over a quarter-wave variable mutual inductance tuned antenna for 10 and 17 meters. Because no radials are required, this antenna has a simple profile. At 17 feet 8 inches, it's easy to fasten to a poop pipe or vent.

Gap Antenna Products (1-407-778-3728) offers several models which operate as vertical dipoles with no traps. They require several ground radials, depending on the model. The shortest model, the Eagle DXPVI, is 21.5 feet tall. It covers 40 through 10 meters. This model does not need radials. It comes with three counterpoises, each 8 feet long. The Challenger DXPVIII covers 80 through 10 and stands 31.5 feet. The Voyager DXPIV covers 160 through 10 meters. At 45 feet tall, it might be hard to convince your landlord about this one. I do not know of anyone using these antennas, so ask around.

Butternut Electronics (1-210-350-5711) makes a small butterfly antenna. This butterfly compact beam covers 10 through 20 meters. Small enough to mount to a chimney, it can be turned with a small TV-type rotator. The boom is only 6 feet long, with a wingspan of 12.5 feet.

HF Mobile Antennas at Home

Hustler (1-817-325-1386) has been selling mobile HF antennas for a long time. The Hustler resonators and masts make a quick and easy mobile combination. You can also use these at home if you have a counterpoise to work them against. An aluminum window frame is fine, as is metal spouting. Even some wire radials will work, too. Hustler also has several models of vertical antennas to choose from. These models will require some sort of radial system.

Hustler also has a new line of of low-profile ominidirectional antennas for 144 MHz, 450 MHz, and 1.2 GHz. The Spirit series looks very good, but they're not cheap. Contact Hustler for more details.

The use of one of the new automatic antenna tuners might be an idea, too. I'm not talking about the built-in tuners the newer rigs have, but rather about a separate automatic tuner. One of the best is the tuner by SGC (1-206-746-6310). It will tune just about anything connected to it. A 108 whip antenna will tune all frequencies. This slender whip antenna can be clamped to a window ledge and be used as a temporary antenna system. Of course, you'll need some sort of ground to get the automatic tuner to work with the whip antenna. Look for places you can hide an antenna like this. Look at your closets, stairwells, and even behind a door for places to hide the antenna.

And finally, the new Outbacker (1-615-899-3390) mobile antennas look like they would work just fine in a hidden location. For more information about the Outbacker mobile antennas, contact your local ham equipment dealer, or an advertiser appearing in *Radio Fun*.

Hidden VHF/UHF Antennas

Operating VHF and UHF is a bit easier because the antennas are much smaller. A mag-mount 5/8-wave atop a file cabinet will work surprisingly well. A 1/4-wave mag-mount on top of the refrigerator works great! (Of course, if you can get these guys out and up high, they'll work even better.)

The Forbes Group (1-916-624-7069) makes a 2 meter and 450 MHz antenna that slips over the vent for the pooper. The antenna, the Ventenna, is so hard to detect, it's almost invisible from the ground. I have no idea how the feedline gets from the antenna to the rig, however. (Down the vent and up through the pooper?) If you want to improve your 2 meter FM, give the Ventenna a try.

The more gain you want in the VHF/UHF frequencies, the larger and longer the antenna becomes. Ground plane antennas are much easier to hide, although they don't have the gain.

At VHF/UHF frequencies, feedline loss can become a factor. The larger feedlines, like RG-8U, are needed for longer runs, but the stuff is harder to hide than the smaller coax. Use RG-58U if the run is short and you can't hide the thicker cable. No matter what kind of coax you use, always get the best. Cheap coax will only bite you in the butt later on.

If you assemble your own cables, then buy the best connectors you can find, too. I don't know if gold-plated connectors are worth the price—I've never used them. I get silver-plated ones with a Teflon center. Don't expect great results with cheap coax connectors.

One way to improve your hidden antenna farm is by attaching the SO-239 connector the proper way. I don't have the space in this column to really get into this, but here are some tips for the proper method of installing SO-239 connectors:

- Use a good connector. No cheapies here.
- Use a good-quality resin core solder. Don't use solder paste.
- You'll need a hot soldering iron. I use an 80 watt iron here.
- Don't nick the braid. It will tear at any nicks.
- Don't reuse a coax connector.
- Install one connector, check for a short with your VOM between the shell and the center pin, then install the other end.
- Solder the braid through the connector holes. They're not there to let the steam out of the coax.
- Don't forget to slip the barrel over the coax before you solder the connector on!

If you follow these tips, you'll be on your way to improving your hidden antenna farm.

Safety First With All Antennas

No matter what kind of hidden antenna you come up with, remember: *safety first*. You must keep the antenna away from people and, of course, critters. The RF produced by a 100 watt transmitter can cause a really nasty burn. You can bet the family jewels you'll be in court if your hidden antenna farm causes someone harm. A good dose of common sense goes the distance in each case of an hidden antenna.

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Joe Carr

antennas, etc.

by Joseph J. Carr K4IPV

Using HF Mobile Antennas in Portable Operations

High frequency mobile operations seem to be coming back after a long period of lower popularity. Some two decades ago, the advent of small 2 meter units, and the now-ubiquitous repeaters, caused HF mobile to go into eclipse. The disadvantages of HF mobile were exacerbated by the fact that the rigs were large, and the cars were getting smaller. The cars are still smaller (as a guy my size can attest!), but a number of HF SSB rigs are now available that make HF mobile operations a lot easier. Some people got back into HF mobile when the sunspots hit a high a couple of years back, and several 10 meter 25 watt (or so) SSB mobile rigs were on the market. At one time, HF mobile was a lot more popular. Indeed, in the 1950s and 1960s if you were mobile you were on HF or you didn't talk to many people.

Portable operations occur when the car is parked. Well . . . not really . . . in the legal sense the operation is still "mobile," but there are situations where one might undertake longer-term operations from a vehicle, but in a parked status. Some examples are emergencies. Over the years three hams have related stories of how HF mobile saved them a lot of trouble . . . and in one case saved a life. One guy was a Swedish (SM) missionary in Sudan. He used a rig that could operate on 75 meters and the adjacent bands where point-to-point was allowed (he was licensed for both). Out on the desert of Sudan, conditions are extremely harsh. If he didn't check in twice a day, search and rescue parties were launched. Another guy told me of being stuck with a busted four-wheel-drive vehicle in the mountains of Arizona during an elk hunt, a long way from anyplace. Still a third told me of becoming sick and snowed-in during a Montana hunting trip. The Montana hunter had an HF mobile unit installed in a travel trailer. One thing that all three of them talked about was that mobile antennas are typically low-efficiency devices, and they worried about being heard when bands were crowded. Each of the three had a different solution.

First Solution: Install Temporary Radials

The SM1-guy who worked in Sudan had a difficult radio situation: operation from a Land Rover in a terrain with few trees for antenna supports and a poor-conductivity soil underneath. In addition, as he made his medical rounds, he would not stay long enough in one spot to make it worthwhile to erect a semipermanent structure. What the SM1 did, however, was to increase the effectiveness of his mobile antenna by adding three or four $\lambda/4$ wire radials to form a counterpoise ground plane. Figure 1 shows how this is done. The radials are connected to either the vehicle body or the antenna mount, and are then stretched out along the ground. Rocks or bricks can be used at the far ends to temporarily hold the radials. The SM1 who gave me this tip recommended that the radials be fanned out as widely as possible, with one going straight back from the vehicle, and the others spaced out as is possible for the given situation.

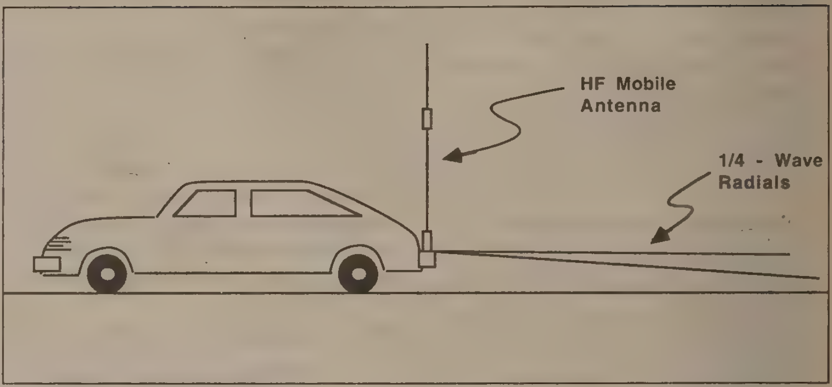

Figure 1. Adding radials increases the effectiveness of the mobile antennas.

Figure 2 shows how a mobile mount can be modified to accommodate the occasional use of radials. Most ball-style HF antenna mobile mounts have three bolts to hold the assembly to the body of the vehicle. One of these bolts can be replaced with a heavy-duty five-way binding post. Be sure to use a star washer under the hex nut. And scrap away corrosion or paint from the underneath side of the fender, or grounding won't be complete. Ideally, use the same screw as is used to ground the shield of the coaxial cable.

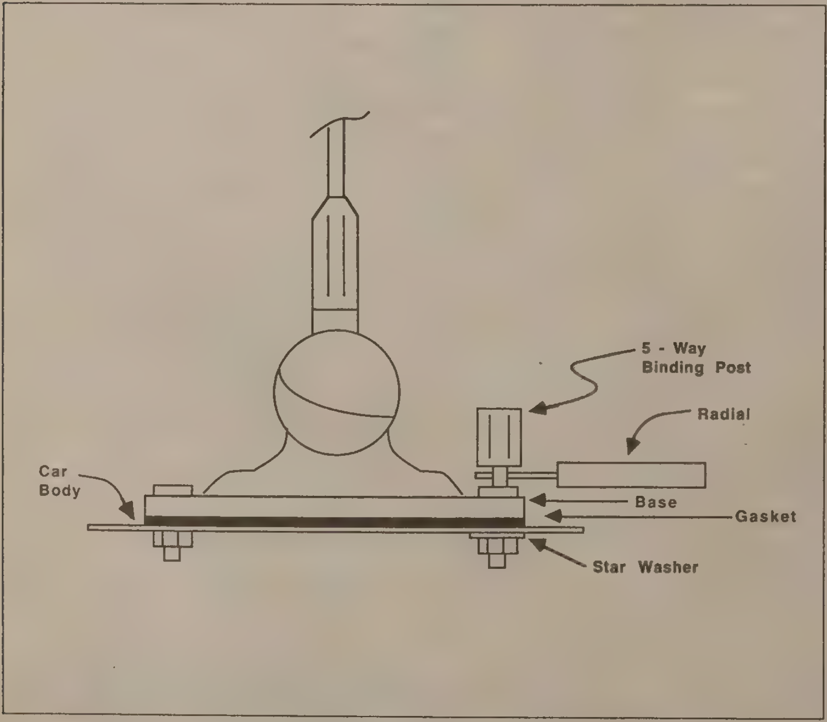

Figure 2. A five-way binding post can be used for connecting the ground radials to the antenna.

Second Solution: Bring a Dipole

The guy who went hunting in northern Arizona had a different solution. He was an elk hunter, and every year made the trek from Tucson in southern Arizona up to the northern portion of the state. Arizona goes from high desert of cactus and coyotes (and rattlesnakes) to forested mountains in the north. On one trip, he was a little too aggressive with his 4X4 and smacked the undercarriage onto a rock outcropping, fatally injuring an axle, transmixer or fribblewitzit or something.

He managed to call for help using his Kenwood TS-430 mobile HF SSB rig operating on 75 meters. In this case, the stuckee made camp, and then unlimbered a 75 meter dipole he had stowed for just such a situation. Fortunately, there were large numbers of pine trees all over the place, and he had plenty of choices for antenna support structures.

A 75 meter dipole is on the order of 122 feet long, with each element being 61 feet. The elk hunter rolled up the antenna, with a 1:1 balun at the center feed point, and 100 feet of 75 ohm coaxial cable, and stowed them in a kid's school knapsack. The sack could then be shoved underneath the seat or in the cargo area of the vehicle.

Third Solution: Make an Inverted-Vee Dipole

The third solution came from both the SM1 in Sudan and the K8 on a hunting trip to Montana, but I'll credit it to the K8 because the SM1 got credit for the radials idea. An inverted-vee dipole is not really the classical inverted-vee (which is a longwire antenna), but rather it is a half-wavelength dipole, fed in the

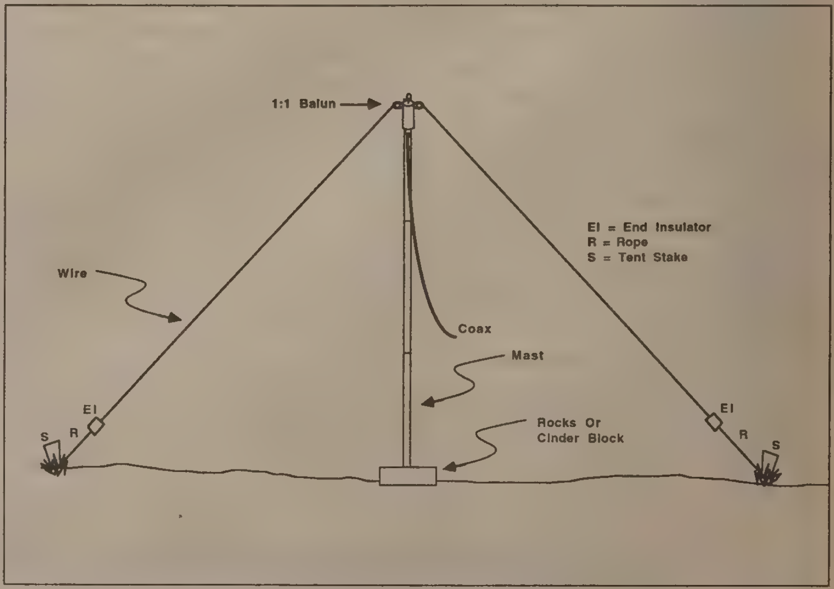

Figure 3. Tent poles or slip-up masts make a dandy inverted-vee dipole.

center, but with the center elevated and the ends drooping towards the ground. The physical length of the inverted-vee dipole is about six percent longer than the normal dipole cut for the same frequency.

The center of the antenna should be at least 20 feet high, and higher is usually better. But a 20-foot pole is a bit much to stow in a vehicle, even in a travel trailer. The K8 in Montana carried five-foot sections of TV antenna masts. These steel masts are enlarged on one end, and crimped on the other, so that they can be slipped together end-to-end to make a longer mast.

Some people will carry a 30-foot slip-up mast in the vehicle. These collapse to about six feet, and can be extended to either 20 feet or 30 feet, depending on whether two or three sections are extended.

Still another way is to use those kinds of tent poles that have a male thread on one end and a female thread on the other, so they can be connected together to form a longer pole.

The bottom of the mast can be held in place for a short time with a cinder block or pile of rocks. But keep in mind that it's a very temporary solution! In some cases, additional guying in the form of nylon rope will be needed to keep the mast upright.

Another way to stabilize the mast is to use a ground plate and stake of the type sold for use with slip-up masts. These devices are 12 to 18 inches long, and can be driven into the ground with a hammer or convenient rock. The top end of the stake sometimes has a metal plate that comes in contact with the ground. Its purpose is not to make an electrical ground, but to provide mechanical stability.

Nth Solution . . . Yours

Well, we've seen three solutions to the problem of increasing the effectiveness of mobile antennas during portable operations. How about you? If you have some favorite means, whether for emergency, or when camping or vanning around the country, let me know. We can share it with other readers. Contact me at POB 1099, Falls Church VA 22041. RF

The Inverted-ZEE Antenna

Enjoy 80 meters with this limited-space dipole.

by Andy Loomis KE0UL

How about another antenna article? This one describes yet another variant of the versitile resonant dipole! I call it the inverted-ZEE because it actually resembles the letter "Z" to observers in passing aircraft.

This antenna evolved from my stubborn insistence that I have fun operating on 80 meters in spite of my property's size limitation—it is far too small to put up a full-size dipole or an inverted-vee antenna.

Now, 80 meters is a great band for statewide and other relatively close-in work—especially at night and until a few hours past sunrise. A rig in the 100 watt class is ideal for checking into the 80 meter regional nets which abound in the morning hours. There is really little need for an antenna to perform well at low radiation angles if working DX is not important to you. Also, propagation via ground waves is limited to about 10 or 15 miles with a rig of this power, so there is not much need for a good ground system either (other than for lightning protection, of course).

Of primary importance is your signal at high radiation angles. A vertical antenna is a poor performer at high angles. That leaves, of course, the ordinary horizontal dipole antenna as perhaps the best-performing easy-to-make antenna for regional communication on the 80 meter band.

Unfortunately, few of us have enough real estate to put up a full-size dipole on 80 meters. Even fewer of us can raise it to a quarter-wavelength in height. Any solution, therefore, requires some sort of compromise to either the length of the antenna or its height. The inverted-ZEE fills the bill nicely. With a careful compromise, we can construct an antenna that gives us a high radiation angle, suitable for enjoying the regional nets, while allowing its performance as a DX antenna to fall off the deep end. The inverted-ZEE is nearly useless in its ground-wave properties. In fact, at a distance of only four miles, the ground wave is so weak that it mixes in with the skywave to produce that familiar "swishing" sound as the two waves go in and out of phase with the varying height of the ionosphere. The inverted-ZEE pushes a healthy signal upward only—exactly where we want it—to be reflected by the ionosphere and back to the earth for excellent communication characteristics between 10 and 500 miles.

"The inverted-ZEE pushes a healthy signal upward only—exactly where we want it—to be reflected by the ionosphere and back to the earth . . ."

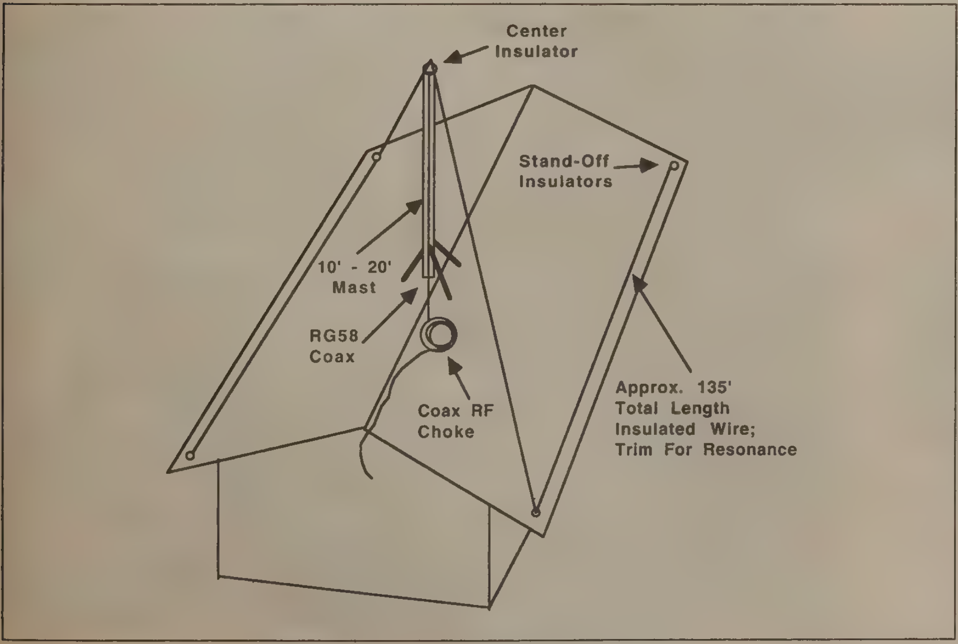

Figure 1. The Inverted-ZEE Antenna.

Construction

To build the inverted-ZEE, begin by building a regular dipole, cut for the 80 meter band, about 135 feet in overall length. Don't bother to measure carefully or to attach the end-insulators yet.

Install a pole or mast on your roof, somewhat centrally located. Use a pole at least 10 feet high, preferably 15' to 20'. The top of the pole will become the support for the center insulator of the antenna. Next, orient the wires toward diagonally opposite corners of your roof, sloping downward from the top of the center-support pole. The distance to the corners is not particularly critical, nor do they have to be of equal length. Attach stand-off insulators (the type used for TV twin-lead) at each corner; route the wires through the insulators. So far, the antenna is looking like an inverted-vee.

Using a few more stand-off insulators, route the remaining lengths of antenna wire, horizontally, along the edges of the roof. Imagine looking down upon your installation—you should be forming a "Z"-shaped antenna as viewed from above. It is not important that the ZEE be symmetrical, either. The idea here is to lay out the remaining wire without regard to the direction or placement of the ends. The only considerations are that we don't fold the antenna wire back on itself or allow the wire to come in direct contact with the roof.

The ends of the wires will almost certainly have to be trimmed in order to resonate the antenna. The easiest way I have found is to replace the excess wire with a length of good string or twine-the waxy kind is excellent because it won't soak up moisture which could detune the antenna on a rainy day. In my installation, I had to remove nearly 15 feet of wire from each end of my antenna to bring resonance into the 80 meter band. Try to remove the same lengths from each end of the antenna.

Cheap RG-58 coax is just fine to feed this antenna. Its loss on 80 meters is essentially nil; and, unless you are running much more than 200 watts, its voltage-handling characteristics should be OK.

My inverted-ZEE showed a minimum VSWR of about 3:1. That's to be expected with a low, makeshift antenna. I simply tune out the remaining mismatch with a regular antenna tuner located at my rig.

In conversations with hams in nearby states, I receive signal reports which equal those of my friend across town who uses a full-size dipole, 50 feet up. Why this is true is a bit of a mystery to me, but I think it has something to do with *most* of the antenna current appearing in the first dozen or so feet near the center insulator. Therefore, *most* of the radiation takes place there, at the highest point.

Because the antenna is located so close to my roof, I think a lot of the downward-directed energy is simply absorbed by my house and is not reflected nearly as well as it would be if the antenna were located over a nice, conductive ground. This has the effect of raising the antenna impedance, thus providing a better match to the coaxial cable than would otherwise be true. Low, horizontally-polarized antennas, installed over good grounds, have very low radiation resistances which make matching to coaxial cable somewhat difficult.

Finally, I think the ends of the antenna, running in the directions they do, tend to cancel the low-angle radiation which would normally propagate as a ground wave. The effect of all these otherwise deleterious effects is to allow the skywave signal to propagate without interference caused by reflections. I am quite sure the antenna would be considered "low-efficiency," for this reason. However, *at high radiation angles* the antenna appears to be just as good as a full-size system—hence the excellent signal reports on the regional nets.

Just as with any other antenna system, take a little extra time to ground the shield of the coaxial cable where it enters your home. This is not only good engineering practice, it also tends to keep RF off the metal enclosures of your equipment, and it affords a small measure of lightning protection. I also like to make a couple of RF decoupling chokes in the coax by rolling it into a seven- or eight-turn, 8" diameter, tightly-taped coil. One of the chokes is located at the antenna's feed point, the other near the base of the center support pole.

If you haven't operated 80 meters because of antenna size problems, try the inverted-ZEE. You may be in for a pleasant surprise! I'll bet this design would work well on 160 meters, too.

I'd like to hear about your results. RF

upgrade . . . don't stop now

by Gordon West WB6NOA

Equipment Modifications

New amateur radio licensees normally begin their hobby with dual-band mobile or hand-held equipment. These sets are preprogrammed for the 2 meter band from 144 MHz to 148 MHz, and the 70 cm band from 440 MHz to 450 MHz. But these factory pre-set band limits may represent only a fraction of the receive capabilities of that new dual-band set. And there is absolutely nothing illegal about receiving frequencies well above and well below the normal ham-band limits, as long as you don't monitor telephone and remote broadcast pick-up frequencies outlawed by the Communications Privacy Act of 1986. Anything else is okay to monitor:

- Public safety—police, fire, paramedics.
- Aeronautical and marine.
- Business radio and industrial radio.
- Wireless microphones and stage mikes.
- Business band, including hospitals and ambulances.
- Military communications, DEA, FBI, FCC, and CIA.

Each manufacturer offers a unique method to enable the wideband receive capabilities of their dual-band equipment. Some manufacturers do not publish this in their instruction books, yet others may include receive modification steps as an insert. Some equipment may give you all-band receive capabilities straight out of the box, yet with other sets you need to hold down specific keys, turn the set on and off, and presto, expand the normal 144 MHz-148 MHz range to cover aircraft down to 118 MHz, and the 24-hour weather broadcasts above 162 MHz—and everything in between.

On the UHF side, expanded receive may go as high as 469.995 MHz, and that covers *almost* everything. However, expanded receive that only goes as high as 459.995 misses all of the police and public safety/emergency medical action above 460 MHz. That's something to think about when considering which radio to buy.

VHF (2m) ideal coverage: 118 MHz-165 MHz. This includes:

- Aircraft (AM): 113 MHz-136 MHz
- Satellites and military: 136 MHz-144 MHz
- Ham: 144 MHz-148 MHz
- Military: 148 MHz-150 MHz
- State, police, fire, ambulance, land mobile: 151 MHz-155 MHz
- Marine: 156 MHz-157 MHz
- Police: 157 MHz-159 MHz
- Railroad: 160 MHz-161 MHz
- Weather and military: 162 MHz-165 MHz

70 cm ideal coverage: 430 MHz-512 MHz. This includes:

- Ham radio 70 cm: 430 MHz-450 MHz
- Emergency medical, fire, and police: 452 MHz-454 MHz; 460 MHz-461 MHz
- Emergency paramedics: 462 MHz-463 MHz
- Land mobile radio: 450 MHz-460 MHz
- "T-band" police and fire: 470 MHz-510 MHz

800 MHz ideal coverage: 855 MHz-868 MHz. This includes:

- Emergency police, fire, rescue.

The Federal Communications Commission has recently ruled that states and municipalities may not enact ordinances forbidding licensed amateur radio operators using amateur radio equipment on frequencies normally reserved for police and other public safety communications. This means that modifying your transceiver to receive beyond normal ham band limits is not a sin. However, there continues to be a cloak of secrecy about this extra capability of dual-band sets to pick up out-of-band signals because of new regulations going into effect next month that could affect the capabilities to unlock your set for additional receive.

Unlocking the transmitter should be avoided at all costs when modifying your own equipment. Accidentally transmitting beyond the ham band could lead to revocation of your ham ticket, a stiff fine, and even some jail time. Even in an emergency, you would never want to transmit on frequencies of another radio service other than ham frequencies. This includes trying to call for help on police channels, or squawking mayday on a Coast Guard channel. Don't do it! Call for help on ham frequencies—this is what your transceiver is designed to do.

But it *does* make sense to dial up the National Weather Service on 162 MHz to see whether you should go out boating with your ham set. You *will* have fun monitoring all the emergency calls in your city. And if you live near an airport, pick up aviation weather calls, plus monitor the aircraft from your dual-band handheld or mobile set.

If you live in *big* cities like Los Angeles, Chicago, and New York, most of their public safety communications take place on "T-band" frequencies that have been "borrowed" from the television service, Channels 14 and 15 UHF. Only a few handhelds will receive "T-band" frequencies above 470 MHz, and only the Alinco DR-600 mobile dual-band ham transceiver tunes T-band channels plus 800 MHz frequencies, too. It's a remarkable transceiver.

If you own a Radio Shack VHF or UHF handheld, they specifically do *not* go out of band on receive. This is because the excellent Radio Shack sets incorporate an extremely selective filter for the ham-band frequencies, and this sharp circuit makes the Radio Shack handhelds terrific performers in areas of saturated frequency air space for clean reception, but they have no capabilities to go higher or lower than the specific ham band they are tuned to. You cannot modify the Radio Shack sets to go beyond.

Photo A. You can tune in the National Weather Service on most 2 meter sets.

Finally, use these out-of-band capabilities prudently. Don't be an ambulance chaser. Don't divulge what you hear, and *never* tune into radio calls that are radiotelephone transmissions or broadcasts from commercial radio stations. Never alter the transmit lock-out circuit, but *do* have fun with expanded receive capabilities which are perfectly legal for the licensed amateur operator. RF

Receive Modification Instructions: *Radio/Tech Modifications*, Volume A—ICOM, Kenwood; Volume B—Alinco, Yaesu, Standard. Artsci Publications; (818) 843-4080.

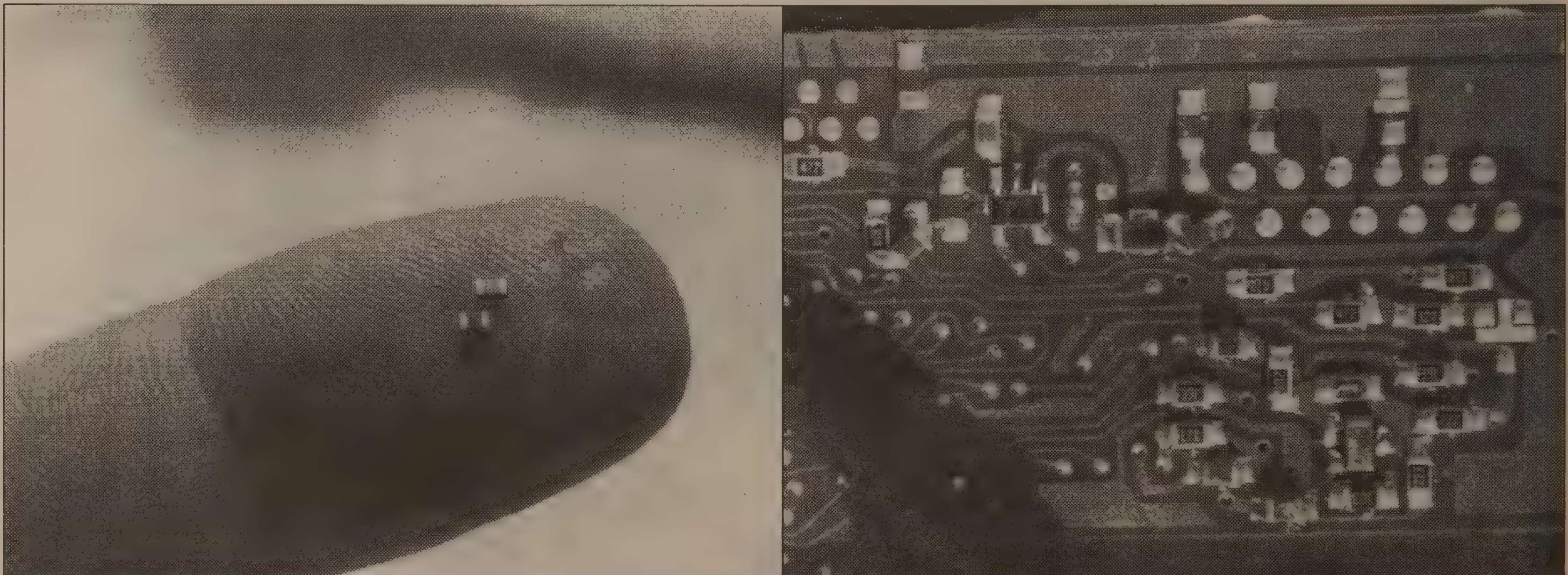

Photo B. Modifications to "T-band" frequencies and 850 MHz may require adding some *very* small diodes.

what's next?

by Carole Perry WB2MGP

Forgiveness Week

Every November for the past five years my ham radio classes have participated in National Geography Awareness Week by creating an original project that makes others more aware of their surroundings. Depending on the students, the projects can range from crafts to reports to video productions. We try to gather our ideas weeks ahead by interviewing social studies teachers and by speaking with hams on the radio on the CQ All Schools net.

This past November, several hams we spoke with tipped us off to the little-known fact that the week of January 23rd is International Forgiveness Week. The kids and I agreed that making people more geographically literate was an excellent idea, but it wasn't the whole picture. The children felt that it was also important to reach out to other people in different places and to be able to communicate with them. What a natural lesson for a ham radio class!

Several of the children did reports about the United Nations and its peace-keeping efforts this year. One of the youngsters brought in a poem written by Robert Muller, former assistant secretary-general of the United Nations. He wrote this piece especially for International Forgiveness Week. I now have a copy of it posted right near my radio:

"Decide to Forgive"

Decide to forgive
For resentment is negative
Resentment is poisonous
Resentment diminishes and
  devours the self.
Be the first to forgive,
To smile and to take the first step,
And you will see happiness bloom
On the face of your human brother
  or sister.
Be always the first
Do not wait for others to forgive
For by forgiving
You become the master of fate
The fashioner of life
The doer of miracles.
To forgive is the highest,
Most beautiful form of love.
In return you will receive
Untold peace and happiness.

Here is the program for achieving a truly forgiving heart:

Sunday: Forgive yourself.

Monday: Forgive your family.

Tuesday: Forgive your friends and associates.

Wednesday: Forgive across economic lines within your own nation.

Thursday: Forgive across cultural lines within your own nation.

Friday: Forgive across political lines within your nation.

Saturday: Forgive other nations.

I now fully intend to incorporate material on International Forgiveness week into my ham radio curriculum as a follow-up activity to Geography Awareness Week. Teachers who use amateur radio in the classroom have a unique opportunity to bring the world into the classroom in a positive, friendly and informative way. That's how each one of us as educators can make a real difference in making the world be a better place for all our children. RF

Photo A. A ham radio teacher can bring the world into the classroom.

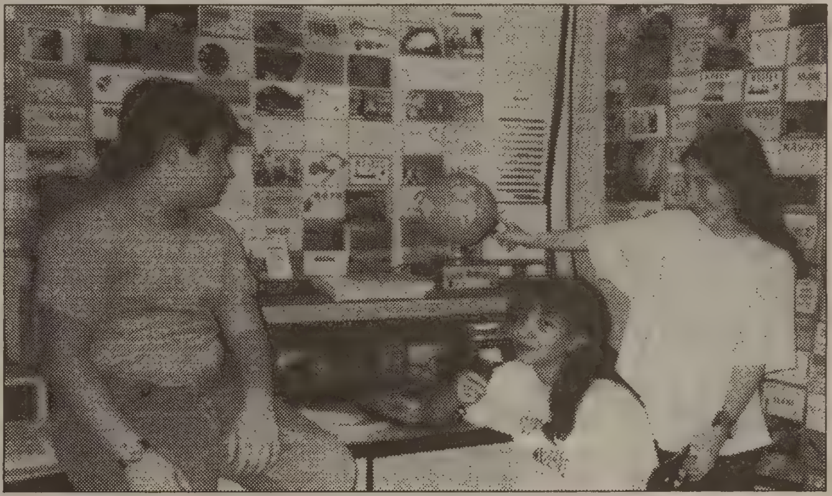

Photo B. Eighth-graders Jordan KB2PYS, Rose KB2QMS, and Renée KB2QMR.

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Radio Fun flea market

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The *Radio Fun Flea Market* costs you peanuts (almost)—comes to 25 cents a word for individual (noncommercial) ads, and 80 cents a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple of months before the action starts; then be prepared. If you get too many calls, you priced it too low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right, and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using.

Send your ads and payment to *Radio Fun Flea Market*, Judy Walker, 70 Route 202 N, Peterborough NH 03458, and *get set for the phone calls.*

The Deadline for the June 1994 Flea Market is March 17, 1994.

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activities calendar

Send your announcements to: Radio Fun Activities Calendar, 70 Route 202-N, Peterborough NH 03458. We'll print as many as space allows, on a "first come-first listed" basis.

MAY 1

BURLINGTON, IA Valley Emergency Comm. Assn. will host Burlington Hamfest '94 from 7:30 AM-3 PM, at the Burlington Drive-In Theater. Agency St. (off U.S. 34 and U.S. 61). Talk-in on 146.790/.190 W0LAC/R and 146.520 simplex. Contact *Chuck Gysi N2DUP, Burlington Hamfest '94, P.O. Box 911, Burlington IA 52601-0911*, or call *(319) 752-3000 (voice/fax).*

YONKERS, NY The Metro 70cm. Network will present a Giant Electronic Flea Market at Lincoln H.S., 9 AM-3 PM, rain or shine. VE Exams. Talk-in on 440.425 MHz PL 156.7; 223.760 MHz PL 67.0; 146.910 Hz; and 443.350 MHz PL 156.7. Mail paid reservations to *METRO 70 CM NETWORK, 53 Hayward St., Yonkers NY 10704*. For details, call *Otto Supliski WB2SLQ, (914) 969-1053.*

MAY 7

MANITOWOC, WI The Mancorad RC will hold its annual Hamfest, starting at 8 AM, at the Manitowoc County Expo Ctr. Amateur/Computer/Electronics Flea Market. VE Exams. Contact w/SASE to *Mancorad RC, P.O. Box 204, Manitowoc WI 54221-0204*; or call *Red, (414) 684-9097 days; Ron (414) 793-4733 eves.*

MAY 8

ATHENS, OH The Athens County ARS will hold its 15th annual Hamfest and Flea Market from 8 AM-3 PM at the City Rec. Center. Indoor space is available only by advance registration; Contact *John Biddle WD8JLM, 80 Wonder Hills Dr., Athens OH 45701. Tel. (614) 594-8901 after 6 PM*. For info, write to *Carl J. Denbow KA8JXG, 63 Morris Ave., Athens OH 45701-1939*. Talk-in on the Club repeater at 145.15 MHz (-600).

MAY 14-15

FT. WAYNE, IN The Ft. Wayne Computer Fair, sponsored by Trade Show Productions, Inc., will be held from 10 AM-5 PM at the Memorial Coliseum. Flea Market. Demonstrations. To reserve space, make checks payable to *Trade Show Productions, Inc.*, and return to: *Mark Hanslip, 143 Schloss Ln., Dayton OH 45418.*

SELAH, WA The Yakima ARC will hold their annual Hamfest at Selah Middle School. Seminars. VE Exams. Breakfast, lunch, and banquet. Talk-in on 146.660. Contact *Dick Umberger N7HHU, (509) 248-3580.*

MAY 15

CAMBRIDGE, MA The MIT Electronics Research Soc., the MIT Radio Soc., and the Harvard Wireless Club will hold a Tailgate Electronics/Computer/Amateur Radio Flea Market from 9 AM-2 PM at the corner of Albany and Main. For reservations and info, call *(617) 253-3776*. Mail advance reservations before May 5th to *W1GSL, P.O. Box 82 MIT BR., Cambridge MA 02139*. Talk-in on 146.52 and 449.725/444.725 - pl 2A - W1XM/R.

WAUSEON, OH The North-West Ohio Tri-County HAMFEST will be held at the Fulton Co. Fairgrounds on State RTE 108 (Ohio Turnpike Exit 3). Flea Market. VE Exams by appointment only; Contact *Tom Hay, (419) 542-6192*, before May 8th. Talk-in on 147.195+ K8BXQ Rptr. Phone *(419) 264-7775* for table reservations or info; SASE to *Mike Sharpe N8RLD, 126 Muntz St., Holgate OH 43527.*

MAY 20-22

ROCHESTER, NY The 60th annual Rochester Hamfest and Computer Show, combined with the Atlantic Div./New York State ARRL Convention, will be held at Monroe County Fairgrounds, Route 15A & Calkins Rd. Sponsored by the Rochester ARA. The Flea Market will run continuously for the entire weekend, starting at noon, Fri. May 20th. For info, call *(716) 424-7184 during weekday business hours*. For a brochure, write to *Rochester Hamfest, 300 White Spruce Blvd., Rochester NY 14623.*

MAY 21

FORESTDALE, RI The Rhode Island Amateur FM Rptr. Service, Inc., will hold their annual Spring Auction and Flea Market at VFW Post 6342, Main St., Forestdale (No. Smithfield). The Flea Market opens at 8 AM, with Auction beginning at 11 AM and continuing until about 3 PM. Talk-in on 146.76. Contact *Rick Fairweather K1KYI, 106 Chaplin St., Pawtucket RI 02861*; or call *(401) 725-7507 between 7 and 8 PM.*

PHILLIPSBURG, NJ The Cherryville Hamfest, sponsored by the Cherryville Rptr. Assn. II Inc., will be held from 8 AM-2 PM at the Warren County Farmers Fairgrounds. Set-up at 6 AM. Flea Market Contact: *Keith Burt KF5FK, (908) 788-4080*. VE Exams Contact: *Marty Grozinski NS2K, (908) 806-6944*. Talk-in 147.375+ and 146.820-.

SACRAMENTO, CA Visit the Carmichael Elks Lodge in Carmichael, between 8 AM-3 PM, to enjoy the annual Hamswap sponsored by the North Hills Radio Club. Talk-in on 145.190- (K6IS). For details, write to *NHRC, P.O. Box 41653, Sacramento CA 95814-0635.*

MAY 22

PLAINEDGE, NY The Suffolk County RC and the Great South Bay RC will hold their Long Island Hamfest/Computer Show from 9 AM-4 PM at the Plainedge HS, Wyngate Dr. Talk-in on 146.685 and 223.86. Contact *Andy Feldman WB2FXN, (516) 928-3868 (eves. 7-10 PM)*; or *Walt Wenzel KA2RGI, (516) 957-5726.*

MAY 28

COLUMBIA, MO The Central Missouri Radio Assn. will hold their 19th annual Hamfest/Computer Expo from 8 AM-4 PM at the Hearns Multi-Purpose Bldg. on Stadium Blvd. Contact *W. "Mac" McKenzie, Jr. K4CHS, (314) 882-7413 days; (314) 442-7619 eves.*

SPRINGHILL, LA The Springhill and ArkLa ARCs will co-host the North Louisiana/South Arkansas Hamfest at Springhill Civic Center. Flea Market. Forums. Commercial Dealers. Contact *David Smith KF5BF, P.O. Box 812, Springhill LA 71075. Tel. (318) 539-3226*. Talk-in on 146.73 and 147.39.

MAY 29

SOREL, QUEBEC, CANADA The Club Radio-Amateur Sorel-Tracy will hold their "Hamfest du Quebec" at The Curling Club. For details, write to *Club Radio-Amateur Sorel-Tracy, C.P. 533, Sorel, Quebec, Canada J3P 5N6.*

MAY 30

SYLACAUGA, AL The 3rd annual Talladega Radio Amateur Club Hamfest will be held at J. Craig Smith Comm. Center beginning at 8 AM. VE Exams at 8 AM sharp, with walk-ins accepted. Forums. Contact *Jim KD4BHH, (205) 245-7825.*

JUNE 4

KITCHENER, ONT., CANADA The 20th Central Ontario Amateur Radio Fleamarket will be held at Bingeman Park. Contact *Jack Knight VE3RGY, 35 Brockville Ave., Guelph, Ont. Canada N1E 5X5. Tel. (519) 823-1358.*

TEANECK, NJ The Bergen ARA will hold its annual Spring Hamfest from 8 AM-2 PM at Fairleigh Dickinson Univ. in Teaneck. Pre-registration required for Flea Market spaces w/power; Contact *Jim Joyce K2ZO, (201) 664-6725*. VE Exams; contact *BARA VE Hotline, (201) 797-0151 before 10 PM*. Talk-in on 146.190/.790; 145.620 simplex.

SPECIAL EVENT STATIONS

APRIL 30

SONOMA VALLEY, CA The Valley of the Moon ARC, WB6DWY, will operate in commemoration of the City of Sonoma and the Valley of the Moon's rich historical heritage, from 1700 UTC-2400 UTC. The station will be operated during the club's annual Hamfest. Listen throughout the day on the General phone portions of 10, 20 and 40m. For a nice parchment certificate, QSL with SASE to *VOMARC, 358 Patten St., Sonoma CA 95476.*

APRIL 30-MAY 1

PHILADELPHIA, PA The Olympia ARC will operate WA3BAT from 1300Z April 30th-2000Z May 1st, to commemorate the 96th Anniversary of Admiral Dewey's triumph over the Spanish Fleet at the Battle of Manilla Bay. SSB/Phone—3.898, 7.268, 14.268, 21.368, 28.368, 145.270, and packet. For a certificate, send QSL and a 9x12 SASE to *Olympia ARC, P.O. Box 928, Philadelphia PA 19105.*

MAY 9-14

VAN ALSTYNE, TX Amateur Astronomers/Hams representing the Southwest Region of the Astronomical League will be operating SE Station K5GH (K 5 Galaxy Hunters) at the 13th annual Texas Star Party. The TSP is located near the Univ. of Texas's McDonald Observatory in the Davis Mountains of West Texas. Operation will be (+/- QRM): 28365, 21365, 14265 and 7265. SSTV and CW contacts on request. For an astronomical theme QSL card, send QSL/SWL report and SASE to *K5GH-TSP, 2619 Bordeaux, McKinney TX 75070.*

MAY 14-15

CARLISLE, PA The Cumberland ARC will operate K3IEC 1300Z-0100Z May 14th and 15th, to celebrate the Club's 30 Anniversary. Operation will be phone and CW on the 160-6 meter bands. For QSL, send QSL and SASE to *CARC, 107 Hilltop Rd., Boiling Springs PA 17007.*

MAY 21

SEATTLE, WA The 2nd Annual NorthWest QRP Club Spring Sprint Contest will be held from 1700 UTC-2100 UTC. Frequencies: 7035-40, 14055-60, 21060 kHz. Logs must be received by June 15th, 1994 by: *Stan Yarema KG7ME, Contest Editor, 3457 12th West, Seattle WA 98119.*

MAY 21-23

OAK PARK, MI The Oak Park ARC will host the 1994 Michigan QSO Party, 1800Z May 21st-0300Z May 22nd; and from 1100Z May 22nd-0200Z May 23rd. Frequencies: CW-1810, 3540, 3725, 7035, 7125, 14035, 21035, 21125, 28035, 28125. Phone-1855, 3905, 7280, 14280, 21380, 28580. VHF-50.125, 145.025, 146.52. Results will be final on July 30th, 1994 and will be mailed to all entrants who have sent in an SASE. Mailing deadline is July 1st. Send logs to: *Mark Shaw K8ED, 27600 Franklin Rd., Apt. 516, Southfield MI 48034.*

MAY 28-29

NORTH SYRACUSE, NY The Liverpool Amateur Rptr. Club will operate WA2ISC from 2000Z May 28th-2200Z May 29th, to commemorate the Mid-Empire State Chapter 293 Vietnam Veterans of America's WatchFire VII Memorial Day fire lighting. SSB operation will be in the vicinity of 7.240 and 14.240. CW operation will be in the lower 25 kHz of 40m and 20m general sub-bands. RTTY on 40m and 20m. Other bands as conditions permit. For a certificate, send QSL and 9x12 SASE to *LARC, P.O. Box 103, North Syracuse NY 13212.*

JUNE 4-5

BRANTFORD, ONT., CANADA The Brantford ARC will operate VE32BA 1400Z-2000Z June 4-5, from the Bell Homestead, to commemorate the 120th Anniversary of Alexander Graham Bell's invention of the telephone (hence the microphone) at the site in the summer of 1874. Frequencies: 7.170, 14.170 and club Rptr. 147.150. For a certificate, send QSL and 9x12 SASE to: *The Brantford ARC, P.O. Box 25036, Brantford ON, Canada N3T 6K5.*

This Month in *73 Amateur Radio Today*

If you don't read the May issue of *73 Amateur Radio Today*, here's what you'll be missing:

- What is the *real* danger posed by RF transmitters? In "The Radar Gun Reality," Wayne Green W2NSD/1 publishes actual testimony before the United States Congress which may astound you. Will the new safety guidelines now under consideration by the FCC ensure your safety? What happens to your body tissue when you are exposed to a radar gun or cellular telephone or even a handie-talkie?
- Gadgets and construction articles, including a very neat "High Performance Audio Filter." This article describes a slick CW filter design which provides narrow bandwidth and resists ringing. A discussion of filter criteria required to achieve optimum results is included. There are schematics for both active and passive versions of the filter; the active one is constructed using three LM324 op amps and 1% tolerance resistors.
- The "Speech Compression" article will help your signal punch through on the HF bands. The author converts a Kenwood desk microphone into a monster compressor which can make the difference between just hearing that rare DX and making a clean contact.
- The "Fast Charger" project will not only recharge all your NiCd batteries; it will *fast* charge them to the correct capacity in as little as 30 minutes. Charge up to 16 cells at one time! A special circuit senses battery condition and prevents overcharging. A quick and easy way to keep your batteries up to snuff.
- Great reviews in the May issue include the new "ICOM IC-2iA Micro-HT." You think you've seen small? Not until you've seen this rig. The ham radio industry steps into a new generation of miniaturization with this 2 meter handie-talkie.
- Great columns every month in *73*, and May is no exception!
- In "Homing In," Joe Moell P.E. K0OV takes you along for the ride as Los Angeles disaster authorities go sniffing for the source of a signal that began jamming the sheriff's frequency after the big earthquake.
- Build "A Universal VFO Project" with help from Joseph J. Carr K4IPV in the May edition of "Carr's Corner." Make this module part of your next home-brew transmitter, receiver, or signal generator! Built onto a nice little PC board, this versatile Variable Frequency Oscillator will allow you to control the operating frequency of any number of projects. Active components include two JFETs and an NPN transistor.
- Get into 2 meter SSB DX without breaking the bank! C. L. Houghton WB6IGP shows how in this month's "Above and Beyond." Chuck is using a pair of Hamtronics kits to convert an old 28 MHz transceiver. Construction and interfacing considerations are all included; you supply the solder.

You should read the May issue, and *every* issue, of ***73 Amateur Radio Today***! Order now and save $15 off the cover price. You'll receive a one-year subscription (12 issues in all) to the best ham radio magazine money can buy for just $19.97. For instant service call toll-free (800) 289-0388. Do it today!

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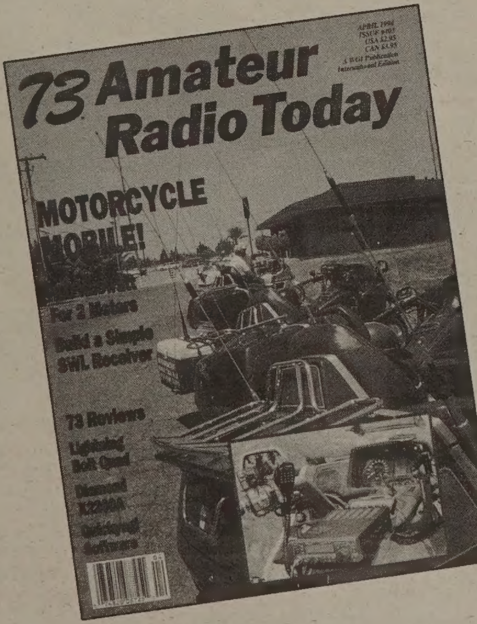

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G9405G992

new products

KENWOOD

There's a new rig coming soon from Kenwood—the TS-60S 90 watt 6 meter transceiver—and it is designed in the same style and configuration as the popular TS-50S HF transceiver.

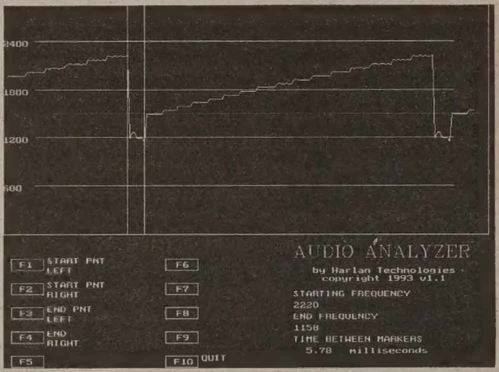
Main features include a full 90 watts output on SSB, CW, and FM modes; 23 watts on AM mode; 100 memory channels; Direct Digital Synthesizer with fuzzy logic control; a large LCD panel with a digital bar meter; a multi-function microphone; and much more.

The suggested retail price for this all-mode transceiver is $1,209.95. For more information visit your favorite Kenwood authorized amateur radio dealer or contact *Kenwood Communications Corporation, P.O. Box 22745, Long Beach, CA 90801-5745; (310) 639-4200.*

HARLAN TECHNOLOGIES

Harlan Technologies has introduced Audio Analyzer, a program which gives a visual representation of some of the audio signals heard over the airwaves. The program uses a PC with a Sound Blaster compatible sound card as the input from the radio. The display can be real-time or from a sound file (.VOC—voice file) so that it can be analyzed over and over. The program was originally used to view slow-scan TV signals during development of Slow Scan II for the Sound Blaster. The program works equally well with RTTY, packet, AMTOR, and CW.

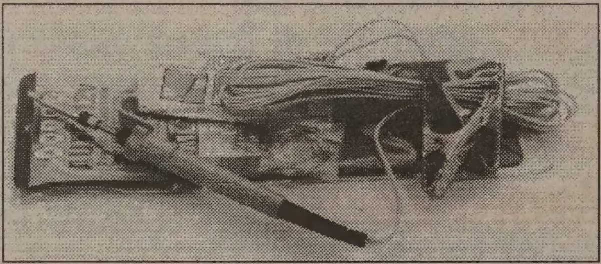
Requirements include a PC with hard drive, VGA monitor, and a Sound Blaster compatible sound card. Audio Analyzer can be purchased for $39.95 plus $5 S&H (IL residents add $2.50 tax). For more information contact *Harlan Technologies, 5931 Alma Drive., Rockford, IL 61108; (815) 398-2683. Or circle Reader Service No. 202.*



AUDIO ANALYZER
by Harlan Technologies
copyright 1993 v1.1
STARTING FREQUENCY
2220
END FREQUENCY
1158
TIME BETWEEN MARKERS
5.78 milliseconds

M.M. NEWMAN CORPORATION

You can make good solder joints just about anywhere with the new Antex Model MLXS portable industrial-grade soldering iron from M.M. Newman Corporation. This iron will operate from a 12 volt automotive or marine battery to provide safe soldering without butane or flames.



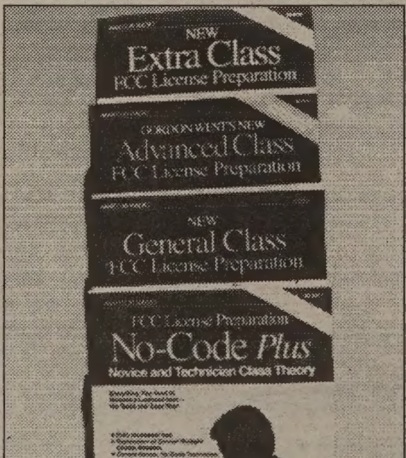
The 25 watt Antex MLXS heats up to 800°F in under two minutes. Supplied as a kit with plastic carrying pouch and solder, it is easy to use and store. It comes complete with two alligator clips and a 15-foot cord for mobility.

The kit is priced at $31.95 (list) complete with a tip, emergency supply of solder, and plastic carrying pouch. For more information contact *M.M. Newman Corporation, P.O. Box 615, Marblehead, MA 01945; (617) 631-7100, FAX (617) 631-8887.* Or circle Reader Service No. 204.

GORDON WEST

Well-known author and *Radio Fun* columnist Gordon West has just finished a four-year project of amateur radio test-preparation manuals with the release of his new Extra Class theory book. "The complete selection of training materials for all radio license grades is a continuous process," said West. "Just as I finish a new book, I go back and begin the yearly revision of another book for the July 1st question pool change."

All of the Gordon West amateur radio license preparation books and code tapes are available from amateur radio dealers throughout the country. For more information or to mail an order, contact *Gordon West, c/o the W5YI Group, P.O. Box 565101, Dallas, TX 75356-5101; (800) 669-9594.* Or circle Reader Service No. 205.



ICOM

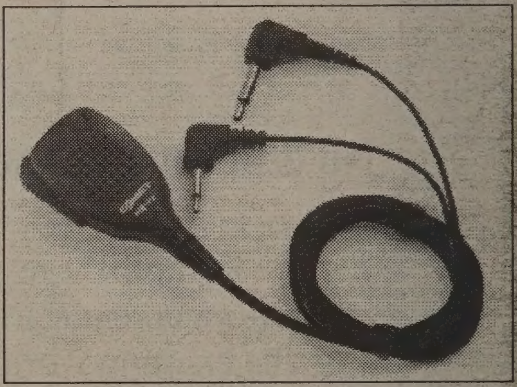
Icom has introduced the new IC-T21A VHF and IC-T41-A UHF handhelds. Packed with innovative new features, these transceivers utilize elastomer construction on the side panels for a grip contoured to fit comfortably in your hand. Combined with a lightweight (11.1 ounce) and compact (2-1/16" W x 4-1/4" H x 1-1/4" D) design, the IC-T21A and IC-T41A are a pleasure to use, even during long hours of operation.

The IC-T21-A transmits and receives on 144-148 MHz; the IC-T41A on 440 to 450 MHz. Both have dual-band receive capability for full-duplex crossband operation between the 2 meter and 70 centimeter bands.

For further information visit your local Icom dealer or contact *Icom America, Inc., 2380 116th Ave. NE/P.O. Box C-90029, Bellevue, WA 98004; (206) 454-8155.* Or circle Reader Service No. 201.

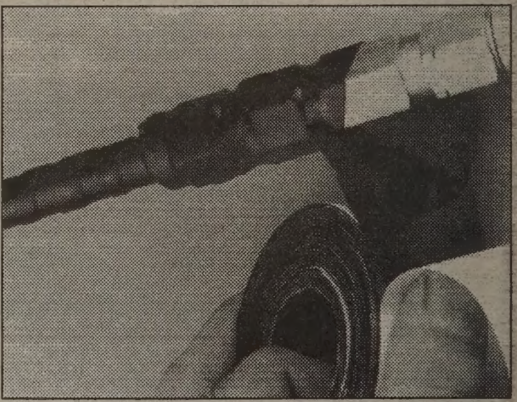
NCG COMET

With the downsizing of most hand-held transceivers available today, Comet has introduced a fine quality speaker-microphone in a compact size to match. The new Comet HM-P2 may be the smallest speaker-mike you'll ever see, measuring approximately 1" wide by 2" high. The rugged plastic shell houses the featherlight unit, which exhibits excellent transmit and receive quality.



The HM-P2 does everything a comparable large speaker-mike can do and features a dynamic microphone element. The HM-P2K version works with Kenwood HTs; the HM-P2F version works with Yaesu, Icom, Standard, Alinco, and others. The suggested retail price is $32.95 and it is available at most dealers nationwide. For more information contact *NCG Comet Antenna, 1275 North Grove Street, Anaheim, CA 92806; (714) 630-4541; FAX (714) 630-7024.* Or circle Reader Service No. 203.

NELCO PRODUCTS, INC.



A self-fusing, non-adhesive rubber tape that resists moisture, corrosion, chemicals, UV radiation and can be used anywhere conventional heat-shrinkable tubing is impractical is being introduced by Nelco Products. NelcoFuse Self-Fusing Tape applies without adhesives, heat, or flame, and bonds itself fully to create a tight moisture-, corrosion- and UV-resistant barrier. Ideal for sealing irregular surfaces, this flexible tape stretches up to three times its size and sets instantly.

NelcoFuse Self-Fusing Tape is offered in your choice of two materials: Butyl Rubber (ETSB), which provides flexibility down to -14°F and superior UV radiation and ozone oxidation resistance; or Ethylene Propylene (EPR), for the insulating and jacketing of splices on power cable from 600 volts through 69,000 volts.

For more information contact *Nelco Products, Inc., 77 Accord Park Dr., Norwell, MA 02061; (800) 346-3526 or (617) 871-3115, Fax (617) 871-3117.* Or circle Reader Service No. 206.

RESOURCE SOLUTIONS

Resource Solutions has announced the publication of the 1994 edition of the *Amateur Radio Mail Order Catalog and Resource Directory.* The new edition is better than ever with more than 250 pages, nearly 200 categories, and more than 1,600 entries of mail-order products and services for hams.

The *Resource Directory* contains helpful tips and a listing of more than 100 free catalogs. Additional categories include catalogs for a fee, radio clubs, VECs, amateur radio bulletin services, foreign radio magazines, and BBSs.

The single issue price is $16 plus $3 postage via priority mail; it is also available at radio dealers everywhere. For more information contact *Resource Solutions, 6050 Peachtree Parkway, Suite 340-228, Norcross, GA 30092; (404) 448-9836.* Or circle Reader Service No. 207.

NEW!

FT-11R/41R

2m/70cm Handhelds

- **Frequency Coverage:**
  Wide Receiver Coverage:
  FT-11: 110-180 MHz RX,
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- Automatic Power Off (APO)
- **Accessories:**

FNB-31	4.8V, 600 mAh Battery
FNB-33	4.8V, 1200 mAh Battery
FNB-38	9.6V, 600 mAh Battery
FBA-14	6 AA Size Battery Case
FTS-26	CTCSS Decode Unit
NC-50	Dual Slot 1-Hour Desk Charger
CA-10	Charge Adapter (required w/ NC-50)

Contact your Dealer for full details.

"Look, alphanumeric display and a 4.8V battery. Terrific!"

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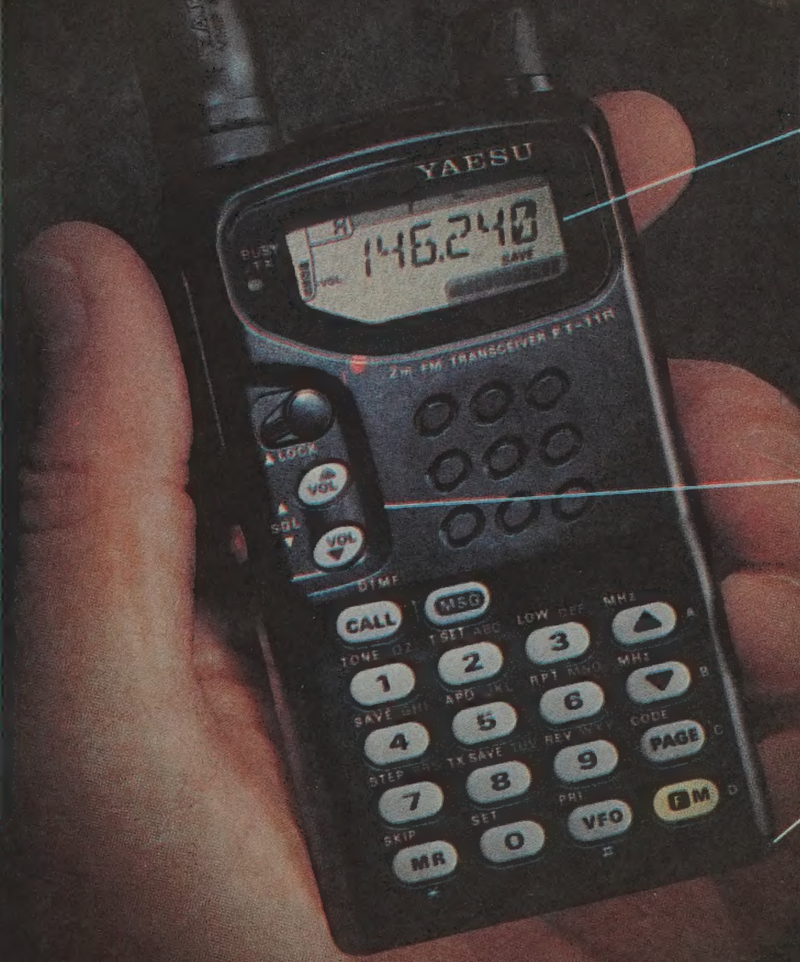

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Full function LCD combines letters and numbers.

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Measures only: 4"H x 2¼"W x 1"D

"Small" is relative, isn't it? It could mean size – which in this case it does. And, it could mean "reduced", which it doesn't! Nothing missing from the hot new FT-11R HT from Yaesu except bulk! You're going to wonder just how all the features of this full-function radio fit in. Until you remember Yaesu pioneered 2-way radio micro technology.

To see what this really means to you, check out all the new features. Like the alphanumeric display. This Yaesu HT first, lets you tag your favorite frequency by name, call sign or number. Or, the new "voltage stingy" battery. It's an industry first for amateur radio. Smaller and compact, the 4.8V battery gives you 1.5 watts on TX. And, if that's not enough, there's an optional drop in, dash mount battery charger.

You see it's not a small time performer. Just small sized. The FT-11R. Another small example of Yaesu superiority. See your dealer today!

YAESU

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Specifications subject to change without notice. Specifications guaranteed only within amateur bands. Some accessories and/or options are standard in certain areas. Check with your local Yaesu dealer for specific details.

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144 MHz/450 MHz single band HTs
More Power !
KENWOOD
KENWOOD

Features

- 3-watt output from MOS FET power module and supplied 6-volt battery (TH-22AT: approx. 3 watts, TH-42AT: approx. 2.5 watts), and 5-watt output with optional PB-341
- Compact design: 2-3/16 x 4-5/8 x 1 in.
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- User-friendly menu system to customize your operating preferences
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- Modifiable for MARS and CAP. Specifications guaranteed for Amateur bands only. Permits required for MARS and CAP use.
- Wide range of accessories to enhance operating convenience and enjoyment

Slim, compact, lightweight. These words describe the exterior of the new TH-22AT Series HTs. Rugged, innovative, sturdy. These words describe what is on the inside. Because along with the beauty, this new series of HT has all the things you want in a portable communications package. Like a streamlined, easy to program interface, one touch controls, and a simplified menu of functions that you can customize to suit your needs. Even a DTMF memory that stores five of your favorite 15-digit telephone numbers for autopatch use. Wide band receive - 136 to 173.99 MHz. A new innovative microprocessor and final amplifier circuit enables a full five watts, while conserving battery power. (The supplied battery provides **3 watts**.) Easy mobile operation with optional PG-3H cable.

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